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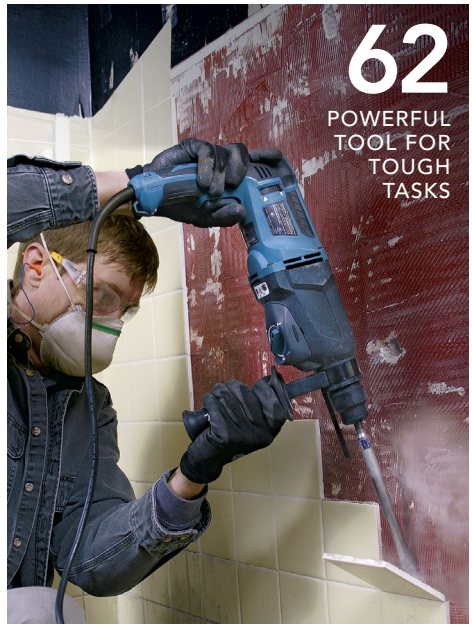

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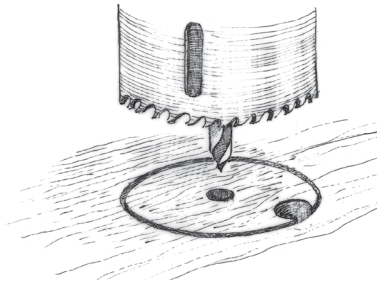

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The Taunton Press
Inspiration for hands-on living®

ON THE COVER: Too often, wood entry doors are finished quickly and poorly. On pp. 38-43, professional finisher Peter Gedrys explains the steps he takes to ensure that an entry door is both beautiful and durable. Photo by Justin Fink.

WHEN THE HOMEOWNER CALLS IT'S DEFINITELY NOT ABOUT THE WINDOWS OR DOORS

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VIDEO: Finish like a pro

Join Project House editor Justin Fink as he visits the shop of finishing expert Peter Gedrys ("Fabulous Finish for an Exterior Door," pp. 38-43) to learn a professional's approach to prepping, coloring, and topcoating an entry door to achieve the ideal balance of beauty and durability.

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Whether you need to solder copper pipe, finish a small concrete slab, or prep a subfloor for tile like in the article on pp. 60-61, head over to our *Mastered in a Minute* video blog to sharpen your skills.

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breaktime

VISIT our online discussion group to ask a question about any aspect of home building. It's free to sign up at forums.FineHomebuilding.com.

Home quality: Production vs. custom vs. high-end custom

CHRIS402 ASKS: I recently purchased land and have been looking at model homes to get an idea of their quality, which seems to vary greatly with the materials used. I'm wondering what makes the high-end custom home feel more "solid" than the others (the walls don't sound hollow when tapped on, the floor doesn't make noise when walked on, etc.).

Florida replies: With a production house, you're going to get whatever the builder gives you. Builders operate strictly on price, so they will cut costs wherever they can. One supervisor may run as many as 50 houses. The subs will be the lowest bidders.

In a custom home, you can expect more finish choices, more attention to details, and better-quality cabinets, countertops, flooring, etc. Custom-home builders will have a list of go-to subs who will produce a higher level of construction and can be trusted not to cut too many corners. One supervisor might oversee five or 10 houses.

High-end custom probably means a full-time carpenter/supervisor, long-term subs, high-end finishes, careful framing, foam insulation, better windows, etc.

AndyEngel adds: In high-end homes, some differences that make the building feel more solid might include ⅝-in. drywall instead of ½-in., plaster wall finishes, solid-core doors, and floor joists sized for an L/480, L/640, or L/720 deflection rather than the code-minimum of L/360.

JIMMIEM adds: I bought a spec/production home in a development and have had to deal with problems related to code-minimum construction. Over time, it has become apparent which houses in the development are production and which are custom based on which have required more fixes.

What do you think makes the difference in home quality? JOIN the discussion online.

Photos: top, Justin Fink; bottom, Rodney Diaz

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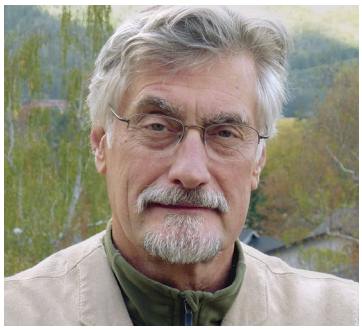
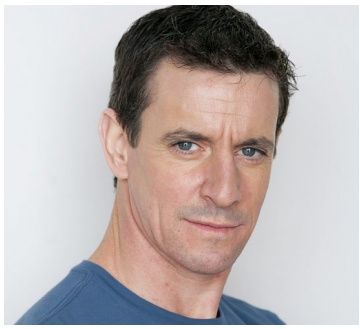


ANATOLE BURKIN **("A Closer Look at Solid-Wood Flooring," pp. 48-53) worked 18 years for The Taunton Press in various roles, including editor and publisher, and has been an avid woodworker and DIY remodeler for even longer. He can't seem to spend more than eight years in any one house before moving on to another fixer-upper. He now lives in Northern California and is going at it again, removing the curse of the 1980s from a ranch home.**

MARK HUTKER, FAIA ("Spaces Within Spaces," pp. 72-75), owns Hutker Architects, which serves Martha's Vineyard, Cape Cod, and greater New England. He has served on numerous charitable boards and is a co-founder and president of the Lyceum Fellowship, which awards international travel grants to architecture students. His second book, *A Sense of Place: Houses on Martha's Vineyard and Cape Cod,* was published by The Monacelli Press in May 2015.



MARK CLEMENT is a carpenter and co-host of the *MyFixitUpLife* show. A native New Englander living in Ambler, Pa., he has built, remodeled, and repaired everything from ocean docks to playgrounds, restaurants, and bakeries for TV shows such as ABC's *Extreme Makeover: Home Edition* and Food Network's *Save My Bakery*—all while neglecting his own century-old American foursquare. In this issue, Mark puts 1-in. rotary hammers to the test (pp. 62-66).

For PETER GEDRYS ("Fabulous Finish for an Exterior Door," pp. 38-43), a stint working in a furniture-restoration shop inspired a career change, and in 1987 he opened his own studio in East Haddam, Conn. Since then, he has offered builders, architects, homeowners, and historians the same quality of finishing usually reserved for furniture. When not in his studio, working on a job site, or teaching seminars, Peter can be found in one of his many gardens.

write an article

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- Custom Builder; Montclair, NJ

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"I absolutely love how everything turned out and want to tell you all again how much I appreciate everything you and Crown Point did to make this come together. I hope to work with you again soon on other house projects we have coming up this year."

-Remodeler; Delmar, CA

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READER FEEDBACK

IN THE SPOTLIGHT

Ice-dam causes

"How It Works" in the December 2015/January 2016 issue (*FHB* #256) makes some incomplete assumptions about ice dams. The discussion assumes that roofs warm and that snow and ice melt because of heat leaking from the house. While that may be true in many cases, there are regions where the roof warms up enough from sun and wind during the day to melt roof snow and ice. The meltwater flows down to the gutters, where it freezes. This phenomenon is common in eastern Pennsylvania and no doubt elsewhere. The Pennsylvania solution was the poll gutter, which your readers might want to research.

—ERIC GROVES
via e-mail

Senior editor Martin Holladay replies: **It's true that the sun can melt snow and lead to icicle formation, and in some instances, even ice dams. The phenomenon can sometimes be seen on unheated garages and sheds. However, it's rare for solar heat alone to create enough ice buildup to cause roof leaks or ceiling damage. If there is a real ice-dam problem on an unheated building—again, a very rare phenomenon—the most common contributing factor is a roof valley. If this possibility worries you, it's wise to design a roof without any valleys.**

If a home has problems with ice buildup in gutters, the most obvious solution is to remove the gutters. Many homes in snowy climates are built without roof gutters. If necessary, a so-called in-ground gutter (a type of French drain) can be substituted for a roof gutter.

In most cases, homeowners who blame their ice dams on the sun are pointing their finger in the wrong direction. While the sun may contribute somewhat to snow melting, the main problem is usually heat loss from the house below.

Positioning subslab poly

I noticed an informational error in the drawing in "All-Around Efficient" (*FHB* #254). The poly vapor barrier is shown below the subslab rigid-foam insulation. The poly should always be directly below and in contact with the slab. I point to Joe Lstiburek's article on his Building Science Corporation website, "BSI-003: Concrete Floor Problems," in which he discusses this issue in depth. This is a small error, but I think it is important—and easy—to get it right.

Thank you otherwise for a fantastic magazine.

—SCOTT KUNSTADT
Brooklyn, N.Y.

I have a question about the order of subslab rigid foam and the poly vapor barrier as shown in the drawing on p. 71 of the October/November issue. The drawing shows 6-mil poly

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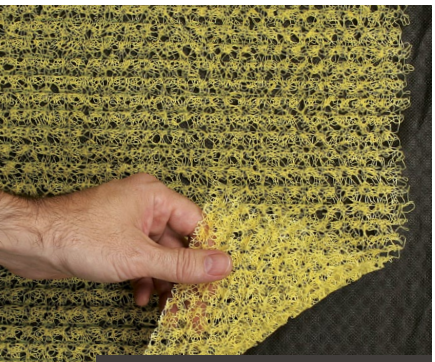

Correction

Benjamin Obdyke's Slicker HP was featured in "Tools and Materials" in issue #256. We listed the cost at about $2 per sq. ft. In reality, this product sells for between 90¢ and $1.00 per sq. ft. depending on distributor and region. It's also available on the manufacturer's website at $205 per roll, which works out to about $1 per sq. ft.

your safety

Home building is inherently dangerous. From accidents with power tools to falls from ladders, scaffolds, and roofs, builders risk serious injury and even death. We try to promote safe work habits through our articles. But what is safe for one person under certain circumstances may not be safe for you under different circumstances. So don't try anything you learn about here (or elsewhere) unless you're certain that it is safe for you. Please be careful.

—ROB YAGID
editor

Email your own letter to us at FH@taunton.com.

under the 2-in. XPS below the basement slab. According to a July 4, 2014, blog post from Martin Holladay on GreenBuildingAdvisor.com, poly should go on top of the rigid foam. Which is the preferred method, or does it not matter?

—KIRSTEN GRIGOR
via email

Author Steve Baczek replies: In reference to the placement of the polyethylene, I don't think it matters in the case of the zero-energy home featured in the article. I typically place the poly above the rigid insulation, not necessarily to be in contact with the concrete but to keep the rigid foam from going buoyant during the casting of the slab. With poly below the foam, I have seen concrete work its way under the foam, making the foam float in the slab. It is a problem nobody wants. I have, however, seen tight installations of foam on which concrete was placed with no problems.

As for performance, poly above or poly below the rigid foam is doing essentially the same work. The key is that the poly be placed between the bottom of the slab and the moisture source—in this case, the ground. The rigid foam does not have the capacity to store water, nor is it a source of moisture. In the Building Science Corporation article, Lstiburek suggests placing the poly in contact with the underside of the slab. But this suggestion is based on the presence of a sand layer placed on top of the poly to battle slab curling. I agree with the approach in that context because the sand layer has the capacity to take on moisture and release it to the slab if no poly exists to stop the moisture migration. This is not the case in the zero-energy home; therefore, the comparison is not exactly correct.

In summary, I don't see a moisture-performance pro or con to placing poly above or below the rigid foam.

Disappointed at insulation choice

I just read "Reinventing the Farmhouse" (*FHB* # 256) by architect Rob Whitten. The house is in my neighborhood, and I drive by it frequently. It is very attractive and nicely situated on its large sloping lot. I prefer traditional-looking vernacular architecture and was pleased with the aesthetics of this new house. Congratulations to Mr. Whitten and all those involved. However, I was disappointed to learn that the insulation used was closed-cell spray foam. While offering convenience in terms of insulating and air-sealing in one step, closed-cell foam is an environmental nightmare. The blowing agent used with this product has a global-warming potential 1000 times greater than CO_2. The amount of energy saved from the insulation will probably never surpass the damage done, in terms of global warming, by this blowing agent.

I know some believe that *Fine Homebuilding* has been emphasizing energy efficiency too much, but global warming is *the* issue for our planet right now. Using closed-cell foam to insulate a new home, when there are so many other choices, seems irresponsible.

—KEVIN ZORSKI
via e-mail

Trim technique

I have installed miles of the same base and cap pictured in the article "Flawless Two-Piece Baseboard" (*FHB* #256). I cannot think of a reason to miter inside corners with flat stock. I was taught to butt the inside corners, and to install the first pieces along walls that are focal points so that the next pieces butt to them and create joints that are invisible from where they will most often be viewed. A mitered joint, even when tight, is visible from most any angle and is fussier to install.

I do miter inside corners of the cap, however, whereas the author copes them. Because of their small size, cap moldings are not prone to much seasonal movement and usually always look tight even when corners aren't perfect. I wouldn't say the author's method is incorrect, but I would say that it is the opposite of how most experienced finish carpenters install baseboard.

—ROB HUSS
via e-mail

Photo: Dan Thornton

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THE MECHANICS OF HOME BUILDING

Electrical

BY CLIFF POPEJOY

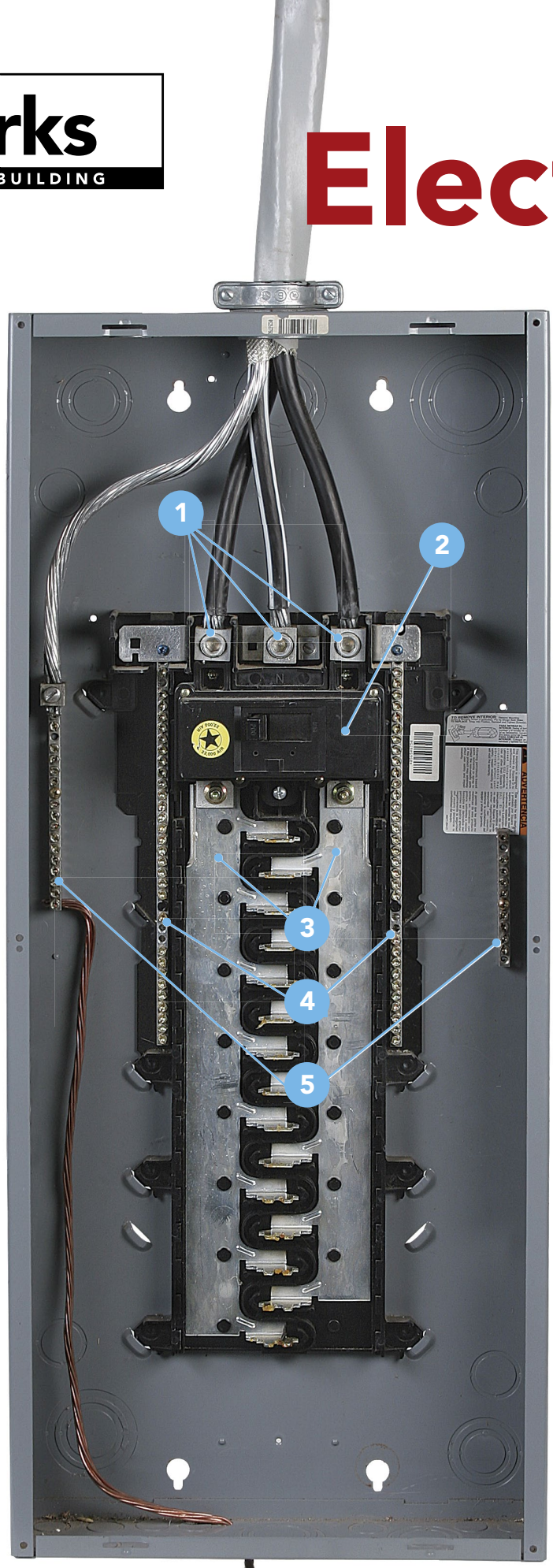
The National Electrical Code (NEC) calls breaker panels like the one shown here *panelboards*, a name given to the earliest whole-house electrical systems—including those with switches and screw-in, Edison-type fuses—which were mounted on wooden or asbestos panels.

By the mid-1960s, breakers had almost completely replaced Edison-type fuses in new construction, so the old panel-mounted fuse boxes gave way to the metal breaker panels that are still being used today.

Although the panel shown here is based on modern NEC requirements, older service/main panel configurations may differ. That doesn't mean your old electrical panel necessarily requires an upgrade. If an old panel meets code requirements appropriate for when it was installed, the workmanship was good, and the panel has been maintained, then an upgrade is not required.

The job of the breaker panel is to distribute the incoming power to the separate circuits throughout a home's electrical system, and to reduce the risk of a fire if something goes wrong with the wiring. Here's how it works.

Cliff Popejoy is a licensed electrical contractor in Northern California.



Panel basics

Beneath the metal cover and beyond the wires and breakers, the design of your home's main breaker panel is simple. Although configurations vary based on panel size, type, and brand, the basic components are similar.

1. Main lugs

These threaded connectors are the main point of connection between incoming electricity and the panel that distributes the power to the house. If the utility is connected, these lugs are live.

2. Main circuit breaker

This is the master switch for the breaker panel. It shuts off the power to everything downstream, including the hot bus bars and all breakers mounted to them.

3. Hot bus bars

These metal bars, typically made of aluminum or copper, are mounted to the panel on plastic insulators and have tabs that connect with and channel electricity to the clips on the back of the branch circuit breakers. Each of the two conductors feeds one side of the hot bus-bar section.

4. Neutral bus bars

The role of the neutral bus bars, which are typically strips of aluminum bored with holes to secure and connect wires, is to act as a hub for the neutral wires returning from each circuit in the panel, completing the loop of electricity. Some panels may have just one neutral bus bar.

5. Ground bars

These metal bars are the central safety hub for the panel and the ground wires for circuits connected to the panel. They create a direct path for errant power to be discharged safely to the earth.

Photos: Rodney Diaz. Drawing: Christopher Mills.

breaker panels

Think safety

Electrical systems are inherently dangerous and complex, even when wired correctly—and many are not. Shown here is a broad overview; additional knowledge of electrical theory and technique is a must before you can safely work on wiring.

The flow of power

With breakers installed and wires connected, the panel is ready to receive power from the utility and distribute it through the house. Here's how the components combine to make a complete system.

1. Breakers control the flow

Besides acting as manual shutoff switches, branch circuit breakers are designed to cut power automatically under hazardous conditions. Thermal-magnetic breakers are the most common type. They trip, cutting off power, in two different ways. When a circuit is carrying more current than it is designed to handle, a bimetal strip inside the breaker heats up, bends, and releases a spring-loaded mechanism to physically break the electrical connection. If there is an inadvertent connection between the hot and the neutral (referred to as a short circuit) or between the hot—or anything energized—and anything that's grounded (referred to as a ground fault), an internal electromagnet will pull the electrical contacts apart.

GFCI breakers are required in areas where there is a greater possibility of shock or electrocution if there's a fault. They measure the power going out on the hot and the power returning on the neutral, and disconnect if they detect a difference, preventing severe shock or electrocution.

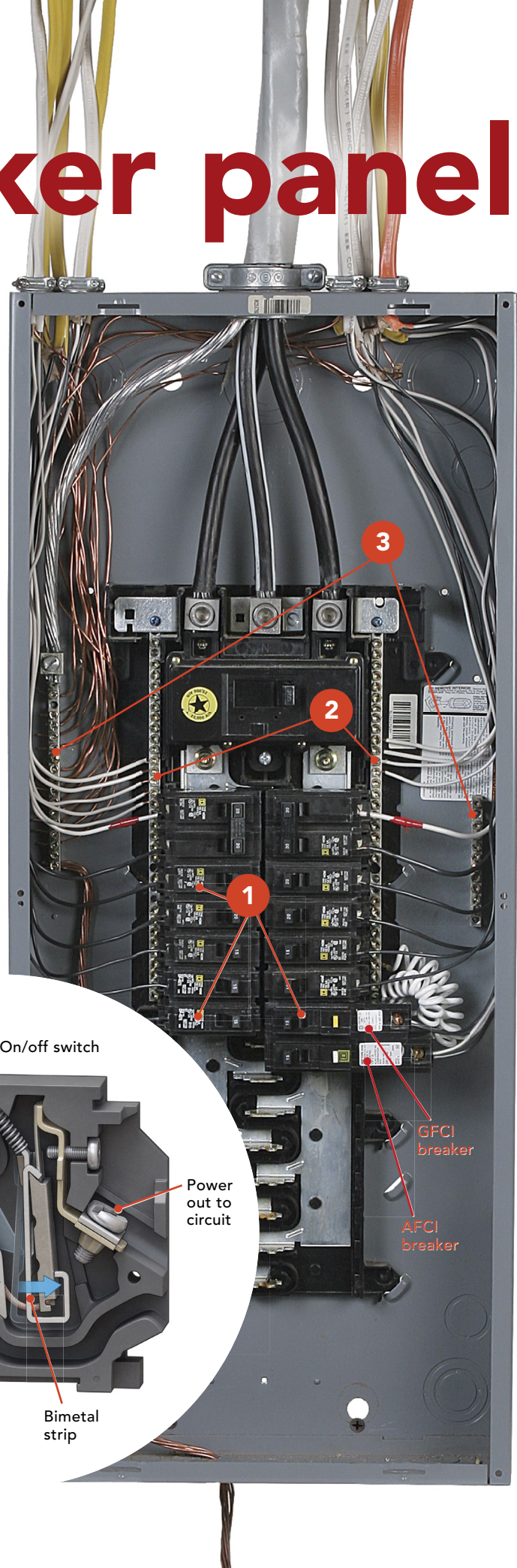
AFCI breakers, now required in most rooms of the house, use a circuit board to monitor and protect against problems stemming from arcing wires (chewed, frayed, or poorly connected wires that spark). While usually not enough to trip a regular breaker, these sparks can be enough to start a fire.

2. Neutrals complete the circuit

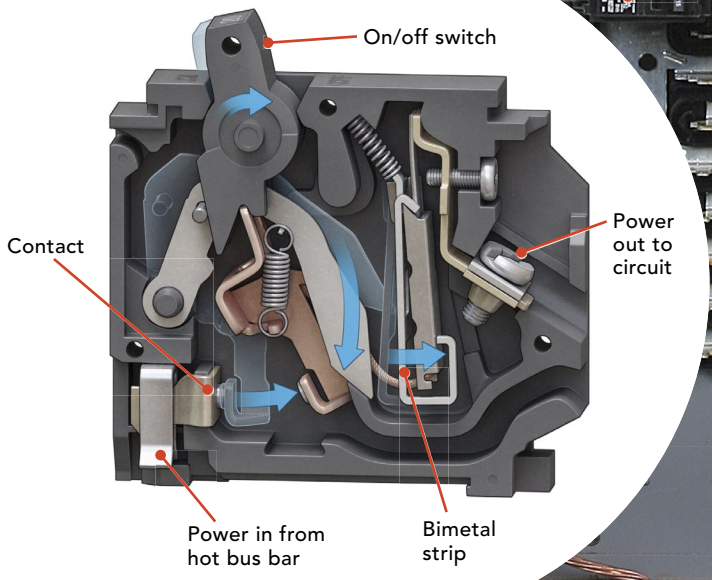
After the electricity has dropped off its energy at the load (lamp, TV, heater, etc.), it returns to the panel via the white-insulated neutral wire. The individual branch-circuit neutrals are connected to a neutral bar, which ties directly to the much larger neutral-service conductor, returning the electricity to the utility to complete the loop.

3. Grounding is for safety

For tools, light fixtures, table lamps, appliances, and any other electrical devices that have exposed metal parts, there is the possibility that a frayed or damaged wire inside might touch an exposed metal part, creating a risk of shock or electrocution for someone who touches the metal. A ground conductor connected to the metal case of the device runs back to the panel, where it connects to an equipment grounding terminal bar (usually referred to as a *ground bar*). This allows the electricity to flow back to the panel, creating a short circuit that will trip the breaker and kill the power to that circuit. The ground bar is connected to the earth via ground electrodes, which also protect the system as a whole in the event of a lightning strike or other high-energy, high-voltage pulse traveling through the service conductors.



Inside a tripped breaker



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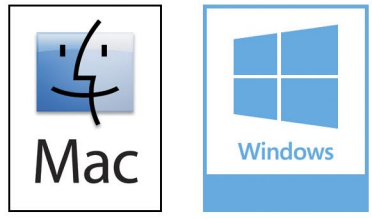

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EDITED AND ILLUSTRATED BY CHARLES MILLER

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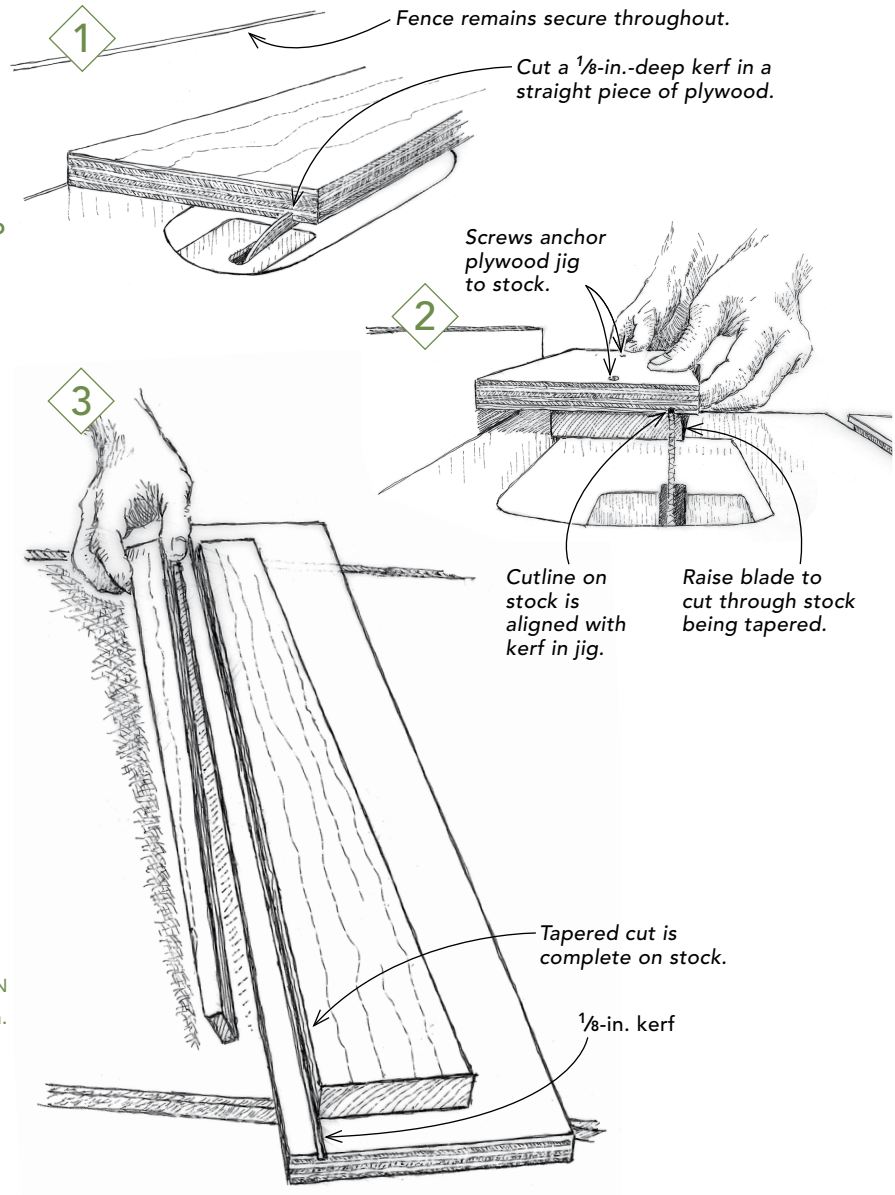
Quick and easy tapering jig

As a remodeling contractor, I have to deal with a world that is seldom plumb, level, or square, which means that occasionally I have to make tapered cuts. I used to dread them, but I came up with a simple jig that makes it easy to cut tapered pieces on a tablesaw.

The jig is simply a strip of ¾-in. plywood that's a little wider and longer than the piece to be tapered. I like plywood because it has a straight edge. You can use 1x or 2x stock for the jig, though; just make sure it's straight. The first step is to set the blade on the tablesaw so that it extends ⅛ in. above the table. Set the fence to cut a kerf in the jig about 1 in. from the outside edge. If your jig is 6 in. wide, set the fence 5 in. from the blade. Next, run the jig through the saw. From this point on, the most critical thing is not to move the fence.

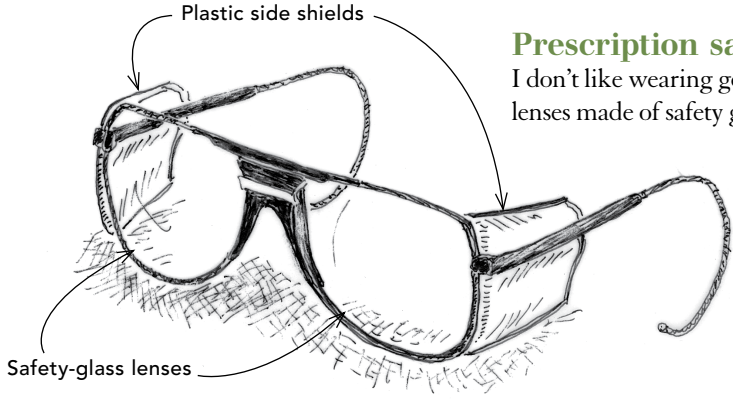
Now turn the jig upside-down. The kerf is the line of the cut. You simply place the piece you want to taper on the jig and line up the cutline with the kerf. Secure the piece to the jig with a couple of drywall screws. Next, raise the blade on the tablesaw a tad higher than the thickness of the board you're cutting, turn the jig right-side up (plywood on top), and make your cut.

—CHRIS GREEN
New Milford, Conn.



submit a tip

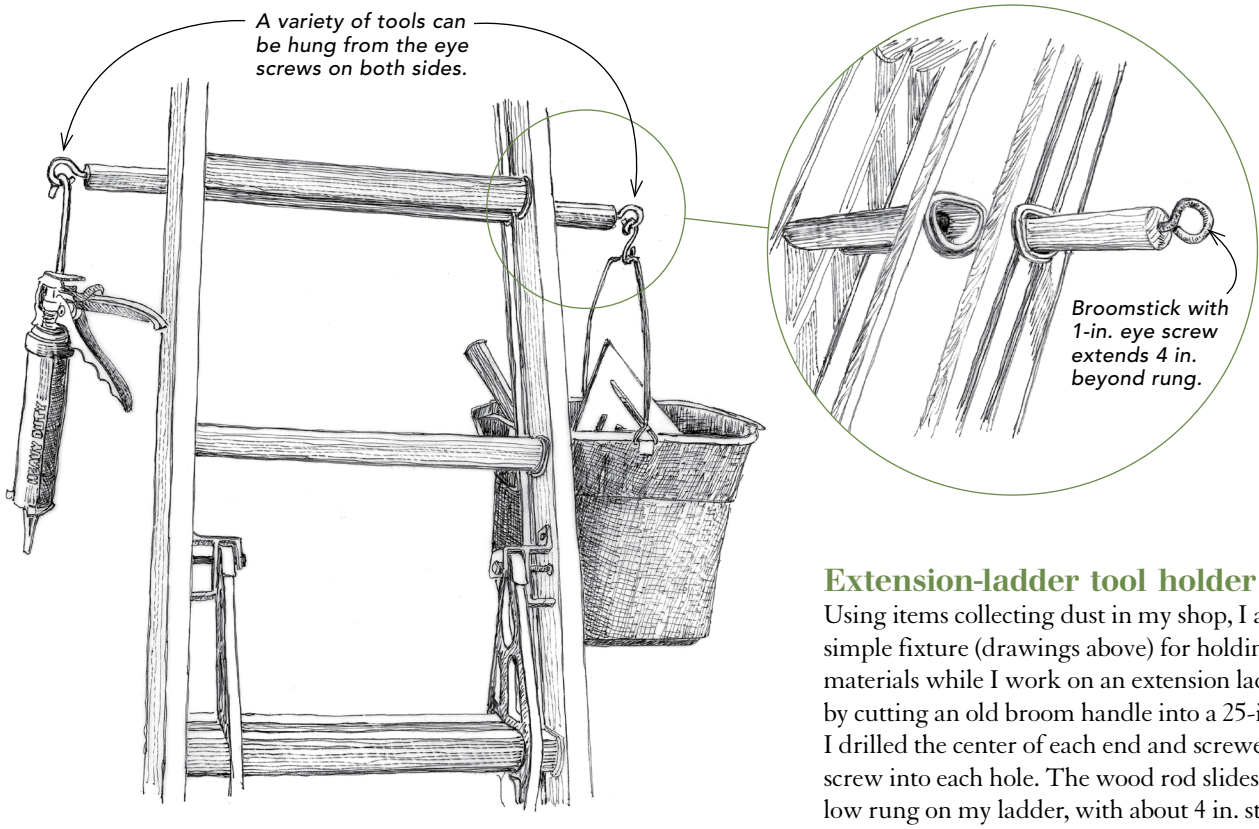
Tips & Techniques is a forum for readers to exchange information about methods, tools, and jigs they've devised. We'll pay for any we publish. Send details to Tips, *Fine Homebuilding*, P. O. Box 5506, Newtown, CT 06470-5506, email them to us at FH@Taunton.com, or upload them to our submit-a-tip blog at FineHomebuilding.com.



Prescription safety glasses

I don't like wearing goggles, so I got my prescription lenses made of safety glass. They provide full safety protection when I attach flexible plastic side shields to the temples. This setup is good for common work. Of course, for anything dicey, I add a polycarbonate face shield.

—DAVID A. BAINBRIDGE
San Diego



Extension-ladder tool holder

Using items collecting dust in my shop, I assembled a simple fixture (drawings above) for holding tools and materials while I work on an extension ladder. I started by cutting an old broom handle into a 25-in.-long piece. I drilled the center of each end and screwed a 1-in. eye screw into each hole. The wood rod slides into the hollow rung on my ladder, with about 4 in. sticking out each side. This gives me the ability to hang items such as a caulk gun on one side and a bucket of tools on the other, so I'm prepared for whatever the day presents.

—JOHN CARROLL
Durham, N.C.

Cleaner drywall demolition

On some remodeling jobs, you need to be especially mindful of the mess that gets created. When demolishing a wall, for example, instead of smashing the drywall to pieces, you can remove it in large sheets if you access the fasteners holding it to the studs. Estimate the stud location using measurements or a few taps of your knuckle. Then run a magnet along each stud. The magnet will stick to the wall directly over screws or nails, making it easy to mark their location. Gently chip away the small amount of drywall mud to reveal the fasteners. Unfasten the screws, or pry out the nails with a cat's paw.

—TOM BOWEN
Fayetteville, Ark.

Foam fixes outlet boxes

If the hole you cut for an electrical outlet in drywall is a bit off, don't just hope that the cover plate will hide the mistake. Instead, fill the void with expanding foam. The foam sticks to electrical boxes and raw drywall edges just fine. Once the foam is hardened, it can be trimmed to below flush and mudded over. Without the foam, the mud would simply crack off with light pressure. The foam gives good backing for the mud and also helps to block air leaks.

—JIM McALLISTER
Portland, Ore.

Tape saves sandpaper

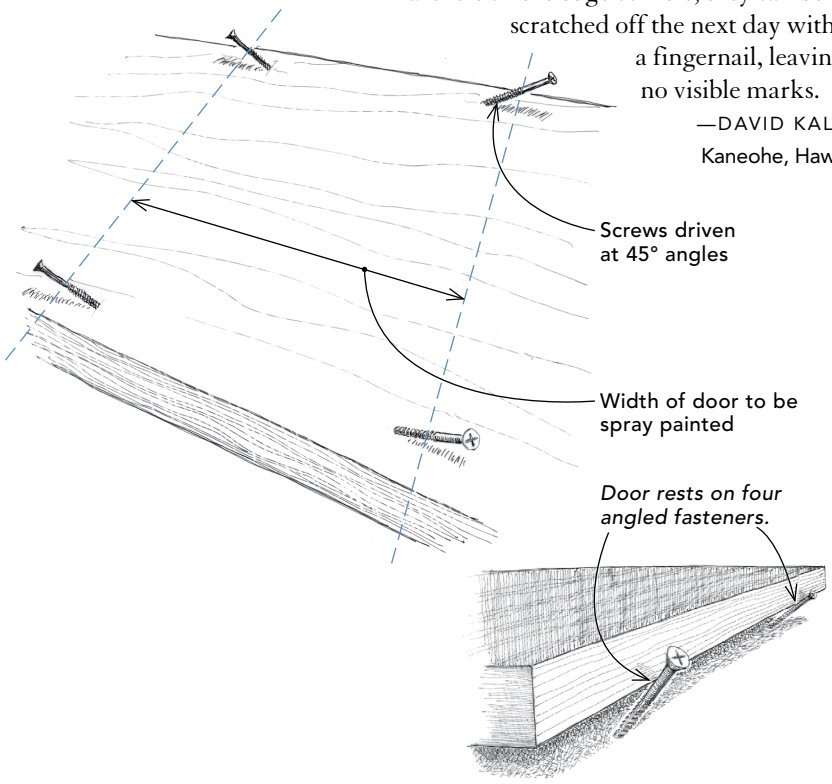
While using my orbital sander, I was having difficulty keeping the sandpaper from ripping where it attaches under the wire clamps. I remedied the problem by putting a piece of masking tape along the edge of the sandpaper before clamping it in place. The first piece I tried lasted longer than the three previous pieces combined.

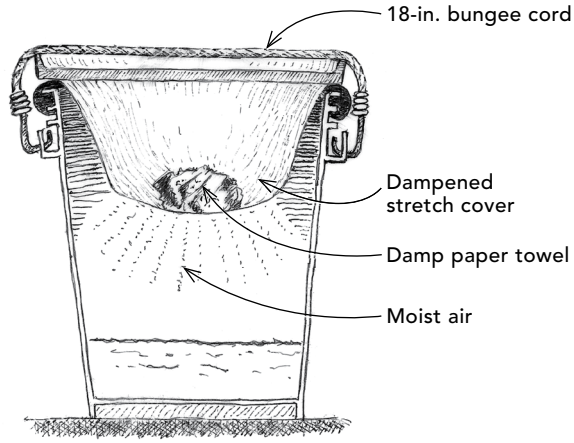
—CARL DITTBURNER
Rolling Meadows, Ill.

Fast drying rack

This simple drying rack is perfect when spraying cabinet doors with lacquer. With it, I can spray a door, wait 15 minutes until the fast-drying lacquer is dry to touch, then flip the door to spray the other side. If any tiny marks are left on the edge corners, they can be scratched off the next day with a fingernail, leaving no visible marks.

—DAVID KALIN
Kaneohe, Hawaii





Don't let the mud get dry

I keep drywall mud in my truck so that I'm ready for small repairs. When I got tired of the ever-present dried mud on the inside wall of the bucket, my wife made this stretch cover. She cut a 24-in. circle out of fabric called "cotton duck," then serged its edge to prevent raveling. She turned it under to form a casing and put elastic in it.

To use the cover, I wet the fabric, stretch it over the bucket, and put a wadded-up damp paper towel in the middle for added moisture. I secure the lid with a bungee cord.

I have tested this setup over an extended period of time, and it works great; the mud stays damp and ready to use. It also makes getting into the mud a lot easier than having to pry off the lid.

—DON MATHIS
Macomb, Ill.

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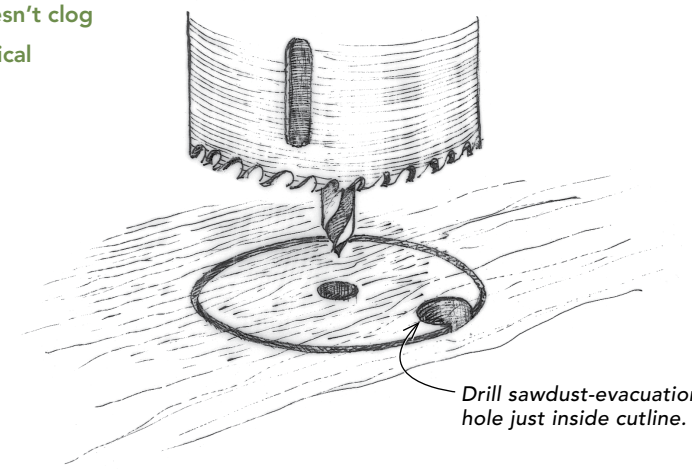
TIP FROM THE ARCHIVES

Improved hole-saw performance

Hole saws are great for drilling large, fairly clean holes in wood, but they can be frustratingly slow. This simple trick speeds up the process and reduces a hole saw's tendency to bind. Simply drill a small hole tangent to the inside of the actual hole. This evacuation hole acts as an exit for the sawdust so that it doesn't clog up the sawteeth at the bottom of the cut. For a cut in a vertical surface, drill the evacuation hole at the top side so that the dust falls out of the cut and into the pocket.

This method eliminates the need to pull the saw out of the hole repeatedly to remove the burned-on chips from the teeth. It also reduces binding and makes the round waste plug much easier to get out of the saw after the cut.

—GREGG ROOS
San Francisco



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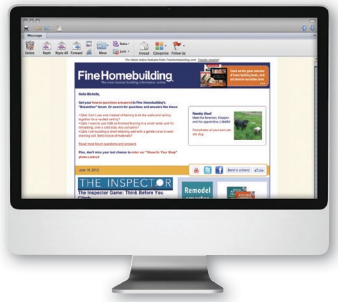

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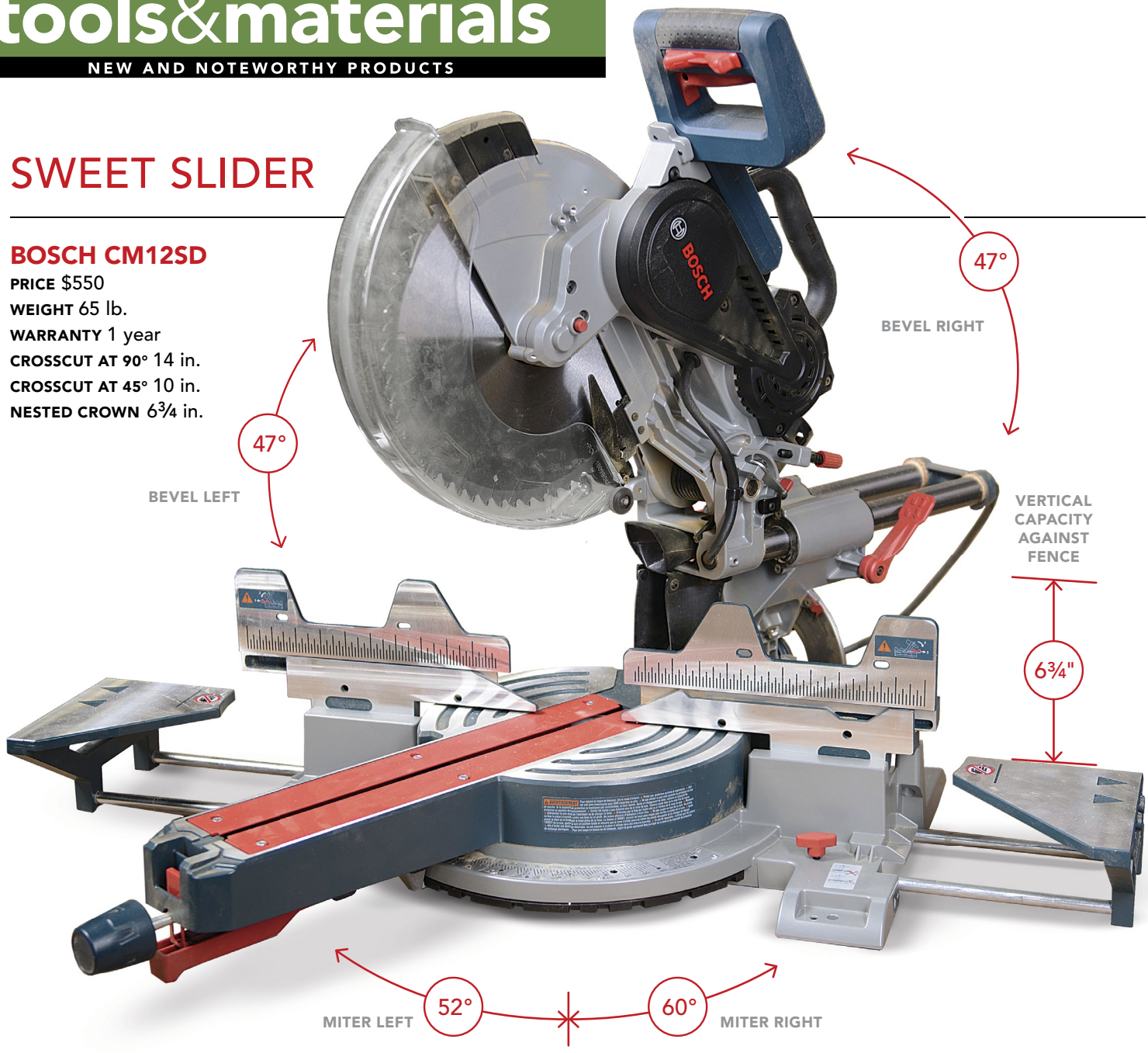
CROSSCUT AT 45° 10 in.
NESTED CROWN 6¾ in.



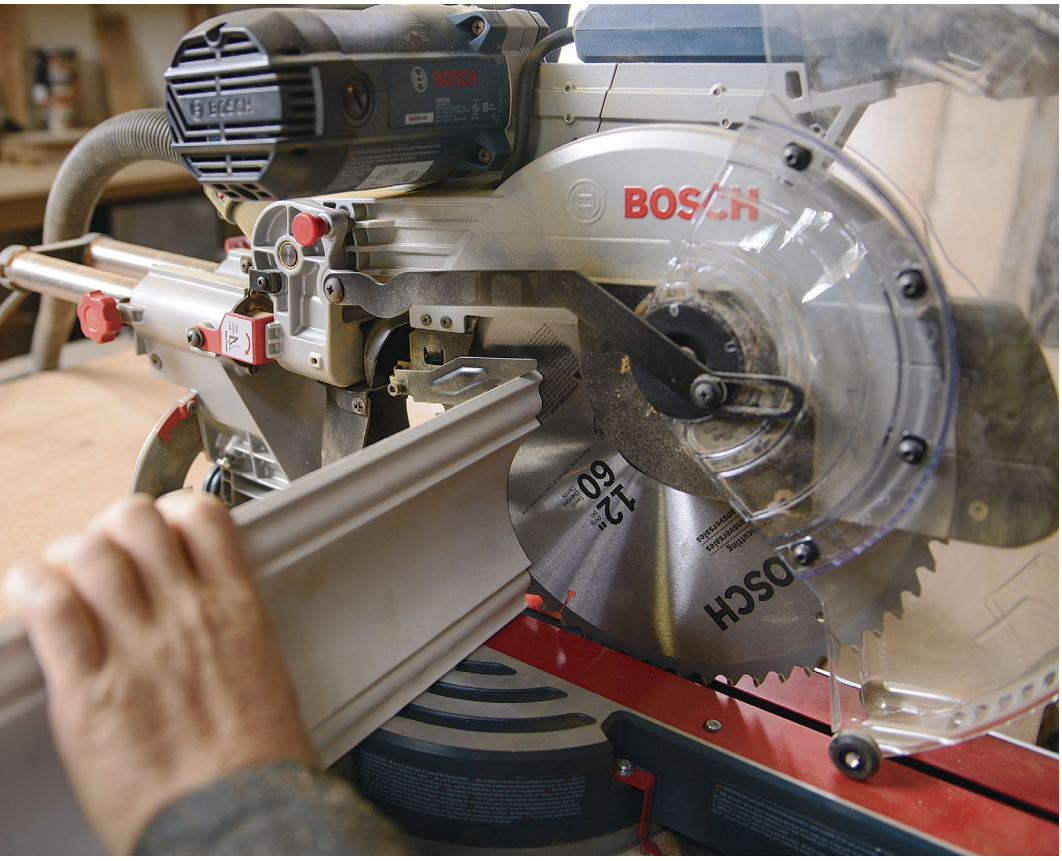
With a Bosch saw as my pick in a recent head-to-head test of nonsliding 12-in. miter saws (*FHB* #249), I couldn't wait to test out Bosch's newer sliding miter saw, model CM12SD. I found the saw to be almost perfectly aligned right out of the box. I only had to make a small adjustment to the 0° bevel stop to get the saw cutting perfectly. While the saw looks like just about every other sliding miter saw, it has a surprising cutting capacity. It can crosscut 14-in. material up to 4 in. thick, and it can cut up to 6¾-in. crown molding or base upright against the fence. I often use 14-in.-wide shelves in built-in bookcases and wine racks, so the extra crosscut capacity is a huge bonus for me.

Flush with features

I am a big fan of Bosch's built-in table extensions, which slide in tight to the saw table when not in use. They help support longer stock without taking up any space during transport. Another plus is that the table sits 4½ in. tall, making it easy to support long boards by stacking three pieces of 2x material. The saw also has plenty of power. I didn't ever feel or hear it bog down, even when crosscutting 4x4 ipé posts.

With this saw, Bosch has introduced a new feature it calls a "crown chop lock." Flipping down the chop lock and tightening the locking knob on the rail positions the head for maximum cutting capacity against the fence. While some might find this useful, I found that I could get the same capacity without using the feature simply by positioning the head myself.

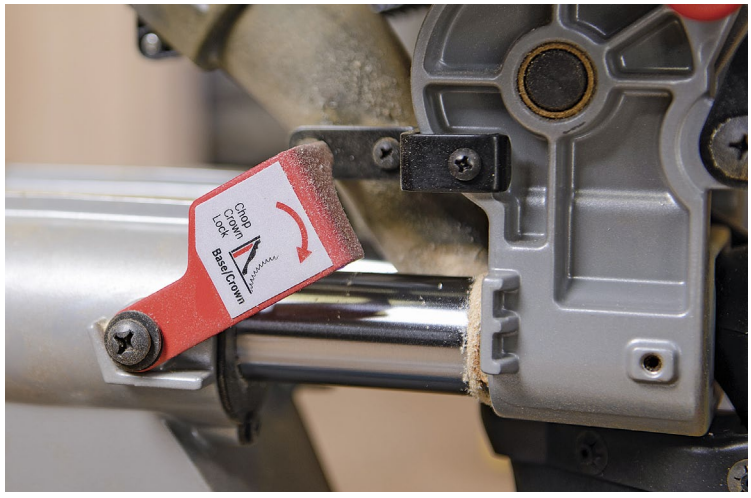
Photos this page and facing page: Nina Johnson

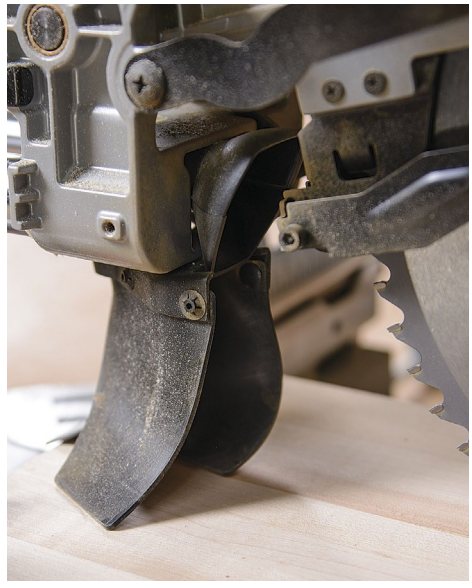


Cutting capacity is impressive. *With the ability to cut 6¾-in. baseboard or crown against the fence, Bosch's CM12SD stands out among sliding and nonsliding miter saws. Crosscut capacity is also impressive: 14 in. with up to 4-in.-thick stock.*

Bevel control moves back. *Bosch eliminated the upfront bevel control found on its previous 12-in. sliding saw and moved it to the right rear. The bevel adjustment, which maxes out at 47° in both directions, is smooth and easily accessible.*

Chop crown lock is new. *Similar to the lock found on Festool's Kapex sliding miter saw, Bosch's "chop crown lock" positions the blade for maximum depth of cut.*





Dust collection is so-so. *Despite a pair of flexible rubber flaps, dust collection was poor with only a dust bag, although it improved with a vacuum. The author found the rubber flaps cumbersome when cutting and positioning stock.*

A few complaints

This saw's handle is a few inches higher than the handle on other sliders I've used, and I found this position to be somewhat less comfortable. I also was annoyed by the overly taut springs on the head, which cause it to spring up violently unless you hold onto the handle as it returns to its upward position after a cut. Although the saw is very accurate generally, I found that there was about a ¼° of movement within the miter detents. Tightening the locking knob solves the problem, but using the knob for common miters is a bit of a pain.

The bottom line

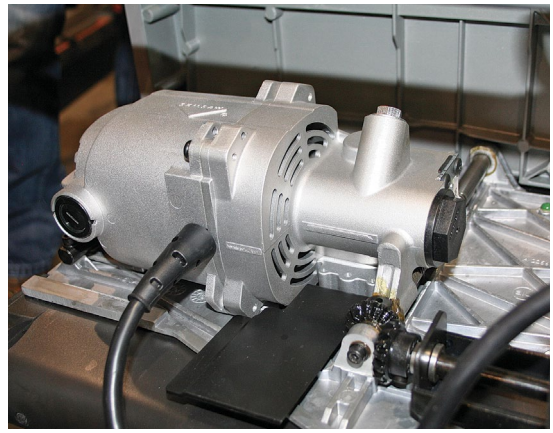
There are no gimmicks with this saw; it's designed to have as large a capacity as possible while being very accurate. It's powerful, and all the functions and controls are easy to use. If I were in the market for a new 12-in. slider, this is the one I would buy.

Paul Johnson, a remodeler in Lake Oswego, Ore.

Worm-drive tablesaw

Skil's worm-drive circular saw has earned a devout following because of its high-torque power train and legendary reliability. According to its manufacturer, these same qualities will make the Skil portable tablesaw just as popular on the job site. Based loosely on the Bosch GTX 1031 tablesaw (Bosch is Skil's parent company), the Skil version has a slightly wider frame and uses the same motor and worm-drive gearbox as the one on modern Skil worm-drive circular saws. Skil claims that the arrangement gives the saw more torque for easier rip cuts in thick, dense materials. The saw has a 25-in. rip capacity and a 3½-in. depth of cut. The saw will be available by mid-March for $379. Look for a complete test in a future issue of *Fine Homebuilding*.

Patrick McCombe, associate editor



Under the hood. *Power comes from the recently redesigned worm-drive gearbox and the electric motor found on the company's venerable 7¼-in. inline circular saw.*

Photos this page: top and center, courtesy of the manufacturer; bottom, Patrick McCombe

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Primo pin nailer

Even after trying Cadex's new top-of-the-line nailer, I'm still unconvinced that I would need to shoot 23-ga. pins that are more than 2 in. long. I did, however, find numerous other things to love about the V2/23.55 ($300). Like its 18-ga. cousin, which I reviewed in *FHB* #245, the V2/23.55 is decked out with features: impeccable machining, a supersmooth magazine, a swivel air fitting, a belt hook, a dry-fire lockout, and numerous well-placed rubber bumpers for protecting delicate surfaces. The nailer is also coated in a high-tech silicone paint that is very grippy, even in sweaty hands, and has so far worn quite well. The V2/23.55 also has a couple of features that are unusual for 23-ga. nailers: a built-in blow gun and a contact safety. Though I liked both features, they proved somewhat troublesome during the testing period. The blow gun started leaking after a few weeks of moderate use (and some time cooking in the sun in the back of my truck). When I contacted Cadex about the problem, the company immediately shipped me a new tool, which has remained trouble free. I did run into another snag that users should be aware of: The nailer will not work without the rubber guard that goes on the contact safety. My suggestion is to keep a spare handy, or to fix the guard in place with a drop of cyanoacrylate glue, or both.

Overall, this is an excellent nailer, with a full menu of features and the ability to shoot both headless and headed nails from ½ in. to 2⅜ in. It might be my imagination, but I feel like headed nails have a little more pull than the headless variety, so I especially appreciate that the tool accepts these nails. I like the nailer so much that it has replaced an older Grex model as my everyday pinner.

Kit Camp, a woodworking instructor and finish carpenter in Portland, Ore.

Superstrong ridge connector

Simpson Strong-Tie's newest metal connector helps builders make stronger roofs in seismic and high-wind areas. The recently introduced HHRC heavy hip-ridge connector reinforces the connection between large engineered or timber hip rafters and structural ridge beams. The connector is adjustable to a maximum hip slope of 35°, so it works with up to a 12-in-12 (45°) roof pitch. The new connector can be used with all common ridge materials, including structural composite lumber (e.g., LVL, Parallam), glulam, and solid-sawn lumber. The HHRC connector includes Simpson's SD10 connector screws for fastening.

P.M.

Photos this page: courtesy of the manufacturers

Take a load off

Installing heavy doors and windows can be a lot easier with a Winbag. The small inflatable bag ($20) works like a blood-pressure cuff to help shim and temporarily hold windows and doors in place during installation. Unlike the inflatable bags carpenters have adapted from locksmiths, who use them for unlocking car doors, the Winbag is thinner (3⁄32 in.), so it's a better fit for construction applications. According to the manufacturer, the device expands up to 2 in. and can exert up to 220 lb. of force. In addition to door and window installations, the tool can be used for temporarily leveling cabinets and appliances.

P.M.

Photo: courtesy of the manufacturer

Easy-to-install shower unit

It shouldn't come as a surprise that falls resulting from getting in and out of the tub are among the most common injuries affecting older Americans. One of the simplest ways to make a bathtub safer and more accessible is to swap the existing 5-ft. tub with an end-drain Ensemble shower unit from Sterling. The Ensemble is available as a shower base for tiled walls (starting at $292) and as a full shower surround with built-in storage shelves (starting at $770). Made from Vikrell solid plastic, the units are available in white and biscuit and can be outfitted with backing for grab bars. After installing several Vikrell shower units, I'm impressed at how easily they go together and how tough they are.

P.M.

Photo: courtesy of the manufacturer

what's the
HELPING READERS MAKE CHOICES

difference?

FINE-FINISH SANDERS

Orbital vs. random orbit

Regardless of the task, sanding is usually the part of the process that most of us don't really enjoy. Having the wrong tool for the job only makes matters worse. When you're ready to put the finishing touches on a wood project and are going the power-tool route, you'll probably want to reach for an orbital sander—or is that a random-orbit sander? They're different tools, and which one is right depends on what you're looking to do. Understanding the big differences between these two small sanders will help ensure that you've got the right sander for the job at hand.

Matt Higgins, assistant editor

ORBITAL SANDER

The orbital sander is the older, simpler, and less expensive of these two tools. It generally has a square foot that accepts a quarter of a 9x11 sheet of sandpaper. As a result, these tools are often called quarter-sheet sanders. (There are also half-sheet orbital sanders.) To create the sanding action, the sander's foot vibrates rapidly in tiny circles, or orbits.

Advantages
The best feature of the orbital sander is its square shape, which allows it to get in corners and up against edges. You can also use regular sandpaper cut to fit rather than purpose-made random-orbit sanding disks. Orbital sanders aren't overly aggressive, so it's hard to remove too much material. Compared to sanding across the grain by hand or with a belt sander, they leave less obvious cross-grain marks, which means that it's harder to ruin your work. The performance and scratch pattern differ from brand to brand, so be sure to test the sanding pattern before assuming that yours won't leave visible cross-grain scratching.

Disadvantages
The main disadvantage is that sanding marks are typically more visible compared to a random-orbit sander. Another drawback is that they don't remove a lot of material. And while some designs are better than others, the clamps that hold the sandpaper in place are less convenient than the press-in-place options used for random-orbit sanders.

Best uses
Orbital sanders are handy for places where a random-orbit sander won't fit, and when only light sanding is required. They are perfect for prepping a surface for painting or sealing, or for knocking down a layer of paint. They are also useful when you're refinishing a wood floor and need to get along baseboards and into corners.

Cost $30 to $50

The telltale square foot of the orbital sander allows it to get in corners and up against edges. While it is random, the pattern created using 100-grit paper clearly shows that extra care is still needed when sanding across the grain.

Photo: Rodney Diaz

TOOL-TECH VIDEO See what orbital and random-orbit sanders have in common and how they differ in a new video by associate editor Patrick McCombe at FineHomebuilding.com/extras.

RANDOM-ORBIT SANDER

Now the mainstay of power sanders, this tool saw a lot of use in the automotive field before it became common for working wood. Using a circular sanding pad that's typically 5 in. dia. (6-in. versions are also available), the random-orbit sander spins but doesn't rotate on a single, consistent axis like a typical disk sander. Instead, the shaft spins and also oscillates off center, creating a random scratch pattern that is never exactly the same.

Advantages

Due to their unpredictable pattern, random-orbit sanders create less visible cross-grain scratching. A random-orbit sander might not be the workhorse a big belt sander is, but it can remove a lot more material than an orbital sander. And many random-orbit sanders have variable-speed switches for less aggressive sanding. The hook-and-loop sandpaper disks most often found on random-orbit sanders are easier to change than the quarter-sheets clamped on orbital sanders.

Disadvantages

The biggest disadvantage of random-orbit sanders is their round sanding surface, which makes it impossible to get in corners. Also, they can remove too much material if held in place too long. On average, they cost about twice as much as orbital sanders, but their improved performance more than makes up for the price.

Best uses

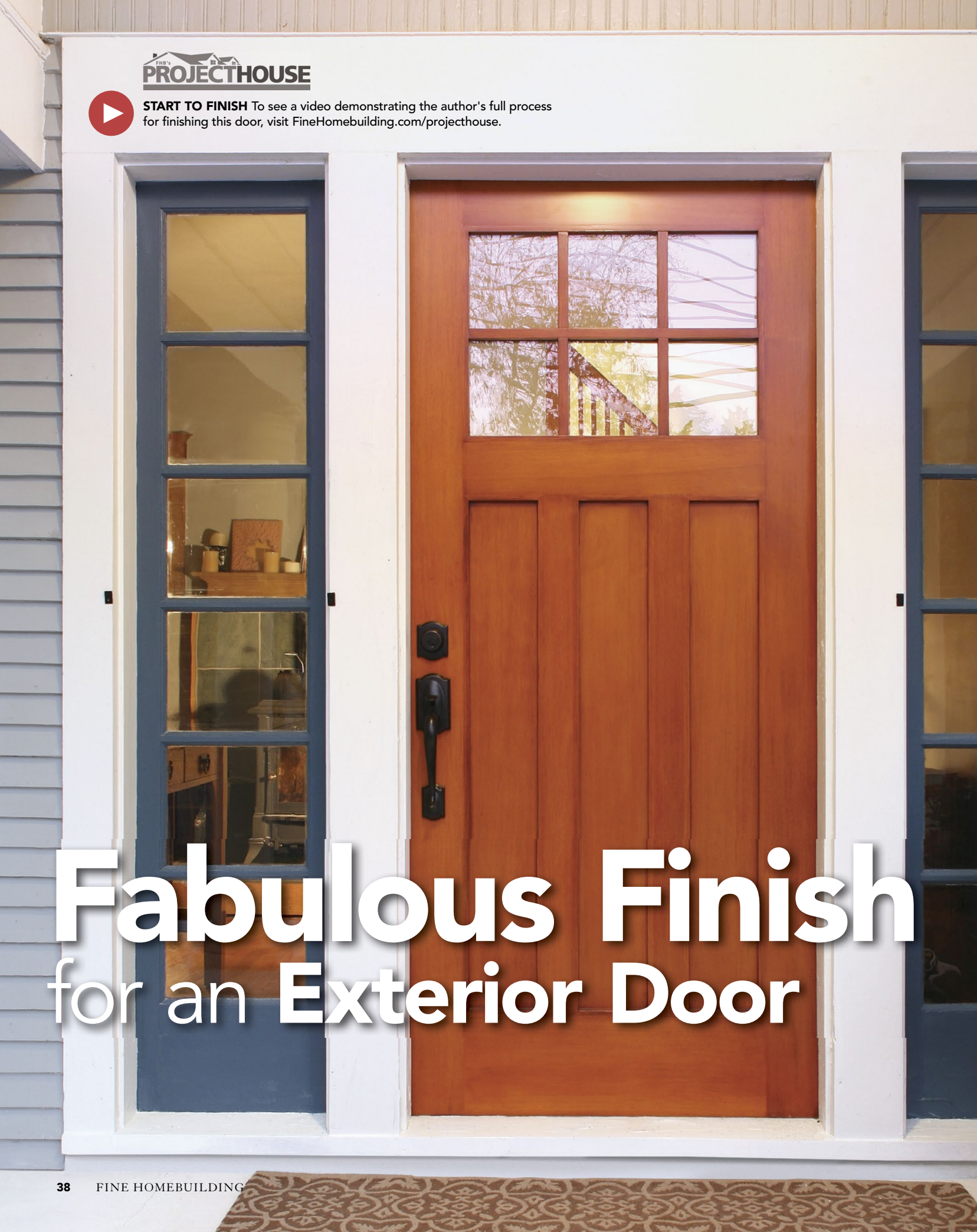
When a decent amount of stock needs to be removed, a random-orbit sander is the preferred tool. It also can be used on big jobs such as refinishing a wood floor and on smaller jobs such as cabinetry.

Cost $60 to $170

The random-orbit sander's oscillations as it spins do not create a distinct pattern. This allows the tool to be used without concern for grain direction. When both tools are outfitted with 100-grit paper, the random-orbit sander removes more material than the orbital sander.

FHB's PROJECTHOUSE

START TO FINISH To see a video demonstrating the author's full process for finishing this door, visit FineHomebuilding.com/projecthouse.



Fabulous Finish for an Exterior Door

Beautify a wood door with dye, stain, varnish, and a commitment to doing the process right

BY PETER GEDRYS

In the world of home building, we too often let time outweigh quality. That's a concern I have day in and day out as a professional finisher. I try to help people understand that making their mahogany paneling, cherry vanity, or walnut stair rail truly shine means putting in the time, and we all know that time means money.

An entry door is a good example. For many people, a one-and-done premixed pigment stain applied to bare wood followed by a couple of coats of varnish is just too cheap and easy to pass up. That's fine as long as expectations match efforts, but a bit more care and the simple added step of dyeing the wood will make a major difference.

Looking at stained wood is similar to looking through a window covered with a thin sheet of plastic; you can still see the grain, but it's muddy and somewhat blurred. By layering the stain over a coat of dye, you can add depth and interest to the color. But achieving this look means more work. For example, the six-lite Douglas-fir door from Simpson shown here required about 22 hours of labor, which included testing colors and making sample boards to try out color combinations.

Is my process the only way to finish a door? Absolutely not. It is, however, one that I have tested with success. Followed carefully, this sequence should ensure that your wood door looks beautiful for years before needing maintenance.

It starts with sanding

After sanding the entire door to 150 grit with a random-orbit sander, it's crucial to sand by hand every square inch with 180-grit and 220-grit paper to bring all surfaces of the wood to a consistent feel before adding any color. This is your chance to get to know the surface of the door, using a raking light and running your hand over the wood to find dents, chips, and spots of glue that could cause problems during the finish stage.

Be methodical with your sanding sequence. I usually do panels and muntins, then rails, then stiles. The specific order doesn't matter, but having a sequence does, because it ensures that you don't miss any spots. It can be hard to see blemishes on the surface of the door, but hands are incredibly sensitive to subtle differences in surface texture. Sand with one hand, and run your other hand lightly over the surface to determine which areas need more attention.

After sanding, remove all traces of dust from the surface of the wood. I don't use off-the-shelf "tack cloths"—typically cheese cloth treated with a tacky material—because to me they are an opportunity

STEP 1 SANDING PREPS THE SURFACE

Never assume that a factory-fresh wooden door is ready for finish. You have to go over every square inch with sandpaper, starting at 150 grit with a random-orbit sander, and then working through 180 grit and 220 grit by hand. Be on the lookout for dents, scratches, and splinters, all of which should be dealt with before you start the dye phase.

Address your sanding. *Avoid arcing sanding patterns by standing in line with the wood grain and moving your hand straight back and forth. Use a backing block and 180-grit paper, then 220-grit paper, to sand every inch of the surface. Sharp edges can't hold finish, so round them over.*

Wipe away dust. *A rag dampened in denatured alcohol picks up dust, and the alcohol highlights any imperfections that need extra attention.*

to introduce surface contaminants. Instead, I wipe the door with a clean, dry cotton cloth, then vacuum it and finish by wiping it again with denatured alcohol.

Unify the wood with a ground color

The wood stains that most people are used to buying and working with are known as pigment stains. The particles of pigment are suspended in a binder, much like the flakes in a snow globe, and must be mixed up so that they don't settle to the bottom. When applied to wood, the pigment lodges in the grain and pores of the wood surface. By contrast, the dyes I use are made by mixing powdered concentrates into a solvent (in this case water), sort of like stirring sugar into coffee. There is no pigment to settle if a mixture of dye is left on a shelf, and when applied to wood, the color penetrates more evenly than a pigment stain, unifying the color of dark and light areas of the wood.

The typical dye solution is made by mixing 1 oz. of concentrated dye powder to 1 qt. of hot distilled water. I prefer to make a stronger solution of 2 oz. dye to 1 qt. of hot distilled water, which becomes my master batch of dye. Now I can take a measured amount from the stock solution and mix in a measured amount of water to create the exact color strength I'm looking for.

For this project, I used a combination of dyes. I mixed each colored solution separately, then combined the solutions incrementally to create a customized color, which I read by wiping test streaks on a white paper plate. After dialing in the desired dye color, I mixed up a quart of this solution, knowing this was more than I would need, and made note of the color combination so that I could reproduce it later.

One of the biggest mistakes people make when applying dye is to put it on too lightly. It's important to apply a copious amount with a saturated pad, making sure to wet the surface of the wood thoroughly. Because the applied solution dries quickly, you may see streaks between overlapping passes during application. Don't panic—these streaks are easy to blend together by passing over the affected area again to reincorporate the color. Watch out for dye accumulating in corners; use compressed air to blow out puddles before they dry.

Shellac for an entry door? You bet

Although vibrant when first applied, dye stain fades faster than a politician's campaign promise. To lock in the dye and to allow me to add another layer of color on top—a process known as glazing—I apply a coat of dewaxed shellac, often labeled as a sanding sealer.

Shellac is not an exterior-grade finish, so you can't use it as a final coating for an exterior door. I've used it innumerable times for the very thin seal coat atop the dye, however. If shellac makes you nervous, you can use an oil-based sealer such as Interlux for this step, but plan on letting it dry overnight. By contrast, shellac dries much faster.

I apply the shellac with a pad made from unembossed paper towels—the blue Scott-brand shop towels are a widely available option. I dampen the pad with denatured alcohol before charging it full of shellac so that a reservoir of finish is soaked in. For detail work, I use an artist brush with bristles made for water-based paints.

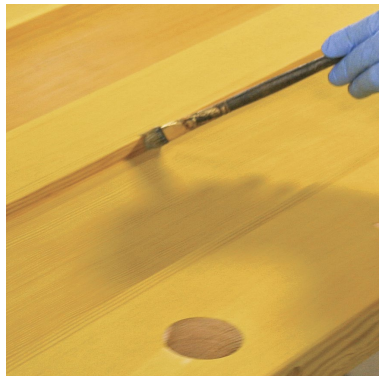
STEP 2 DYE CREATES THE GROUND COLOR

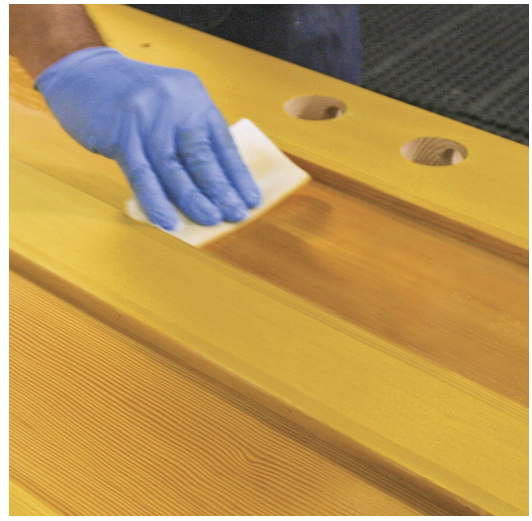
Working with dyes is about as easy as it gets. Add the powder concentrate to hot water, stir it well, strain the mixed solution, and apply with a pad. If you've never used dye, remember that it's part of a layered color scheme. It will dry to a dull, flat color that's very different from how it looks during application. Don't worry; just trust the process.

Don't just dump it in. *To control the mixing rate of the dye to the hot water, hold the measuring cup in one hand, and then tap the top of that hand to shake the dye into the water.*

Apply dye liberally. *Use a brush for details and a pad for flat areas, wetting the surface of the wood liberally, then wiping up the excess.*

Lock in the dye. *To seal the dried dye, apply a thin coat of dewaxed shellac to all surfaces of the door, again using a brush for the details and a pad for the flats.*





STEP 3 GLAZING CREATES DEPTH AND INTEREST

Essentially a pigment stain applied over a coat of sealer, a glaze gives you control over your color. This translucent layer not only enhances the color of the underlying dye to add depth to the finished color, but it allows you to finesse problem areas. Contrasting wood tones can be blended, dark areas can be made light, and light areas can be made dark. If you don't like what you see, you can wipe it off with mineral spirits. When I'm happy, I let the glaze set up and then lock it in with oil-based sealer.

Mix up a glaze. *After combining the gel stains to create your color, add mineral spirits and a bit of glaze base to create a creamy mixture that applies smoothly and dries a bit slower.*

Work in sections. *Start with the panels, then move to the rails and stiles, and then the muntins, stopping at changes in grain direction between pieces. Blend the surface with a dry soft-bristled brush, unloading excess glaze from the brush onto a paper towel.*

Scuff sand. *After the glaze coat has set up, apply sealer, let it set, and then lightly scuff the surface with 320-grit sandpaper to prepare it for varnish.*

Once the shellac is dry, I hand sand it with 320-grit paper so that the glaze—the next step in the process—has something to cling to when applied. I use a light touch here; the coat of shellac is very thin, and I don't want to sand through and into the dyed wood below.

Give the glaze some slip

A gel stain alone can be used as a colorant over the sealed dye, but I prefer to combine it with an alkyd glaze base—essentially a thick base that can be combined with an oil stain in order to extend the working time of the stain. I start with one part glaze base, one part mineral spirits, and two parts gel stain, then adjust from there. I like the mixture to be about the consistency of heavy cream, which gives me good control when blending and softening the glaze.

A glaze coat doesn't need to be thick, and a few ounces goes a long way. I prefer a pad for applying this coat, but a brush or cloth is fine, too. Again, I work sequentially, starting with the panels, then moving to the rails and stiles and finally to the muntins.

The glaze can be feathered with a dry softener brush to create a soft, even color; removed in the center of a panel and pulled into the corners; or pounced with a brush to create light and dark areas. You

can have fun with it. If you don't like what you see, just wipe the surface before it dries, and start again. If the surface has started to become tacky, wet a paper towel or a rag with mineral spirits to remove the glaze from the sealed surface. When you're happy with the look, let the glaze dry overnight.

Once the glaze is dry, lock it in with a coat of oil-based sealer. I don't recommend shellac here because you're closer to the exterior face of the finish. Let the sealer cure, sand the surface lightly with 220-grit or 320-grit paper, hit it with the vacuum, then wipe it down with a cloth dampened with a mixture of water and denatured alcohol. Before adding final clear coats, though, fill the nail holes.

Wax color sticks are fine for filling nail holes in most applications, but I don't like them for an exterior door because of the potential for sunlight to soften the wax. Instead, I use WoodEpox, a two-part epoxy filler that I mix with a bit of dry earth pigment. Choose a pigment that matches the dye color already applied to the door, which allows you to then apply glaze over the filler to create a nice match with the rest of the door. I apply the filler with a gooseneck knife, and since it is slow-setting, it can be wiped smooth easily with a moistened gloved finger. As I like to tell students, if your eye doesn't pick it up, it's not there.

At least five coats of varnish

You have a lot of choices for the topcoat of an exterior door. Here, I used McCloskey Man O' War marine spar varnish, a commonly available product that provides solid quality at an average price.

Even if you don't want the look of a glossy topcoat, it's worth applying a gloss sheen. It has better clarity and can either be buffed to a satin sheen with Scotch-Brite pads or be finished with two coats of satin (the far easier option) to achieve a lower luster.

VOC regulations are changing the finishing game, and the lower VOC formulas (McCloskey 6505 series) are nowhere near as user-friendly as the standard (7505 series) formulas. My advice is to skip the low-VOC formulas because they are maddening to work with. No matter how carefully I apply them, and even when I use the best brushes in my arsenal, they still dry to a streaky appearance.

Even when using the 7505 series, I have noticed that while I used to have to thin the varnish prior to applying the first coat, the formula is now so thin that any further reduction would be counterproductive. That said, if the varnish you use is thicker, you can certainly thin it before application (a brushing thinner is a better choice than mineral spirits), and there are simple tricks for achieving the correct viscosity.

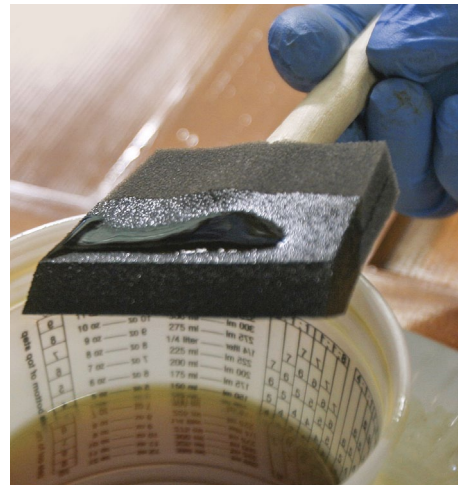
STEP 4 VARNISH ADDS PROTECTION

I consider five coats of varnish to be the minimum for a newly finished door. Factor in drying time of 24 hours for each coat, followed by sanding to prep for the next coat, and it's easy to see why some people cut corners on this step by only applying one or two thick coats. Do it right, though, and the extra coats ensure that the door can go for several years before needing to be recoated.

Epoxy for the holes. *A two-part epoxy filler mixed with dry pigment creates a tinted filler that's easy to pack into nail holes or blemishes.*

Sealer makes life easy. *Because the glaze is sealed, excess filler can be wiped away easily, and glaze can be dabbed on to match the rest of the finish.*

Gauge the viscosity. *Let the stirred varnish run off the end of a mixing stick while counting (one-one thousand, two-one thousand, etc.). If the stream changes to drips at around the four count, you're good to go. If it takes much longer, thin the finish and test again.*



Charge the foam. *After wetting the foam brush with mineral spirits, dunk it several times into the varnish, letting the finish soak into the foam between each dunk. This loads the foam with finish for a better application.*

For applying varnish, I use an artist's brush for the detail work and switch to a disposable foam brush for the panels, rails, and stiles. For some, the idea of using a cheap foam brush flies in the face of the well-established belief that if you want a good brush, you have to spend good money. That's not always true. If it's a good foam brush (one where the tang extends close to the tip of the foam for full support), you can lay an even, bubble-free coat of finish that rivals any produced by an expensive brush, and you can save yourself the cleaning and waste solvent involved in the latter. If you use satin or semigloss varnish, stir it every few minutes while working so that the flatteners

No brushmarks and no bubbles. *A quality foam brush—one with plastic supporting the foam—lays down a smooth coat of finish that's free of bubbles and brushmarks. Apply the coats in the direction of the grain while holding the brush at a 45° angle to the surface of the wood (above). Come back over the finish with the brush held almost perpendicular to the surface to tip out the finish (below).*

RECIPES FOR SUCCESS

Here are the products and mixture ratios used on the door shown here.

WATER-BASED DYE

- 1 qt. hot distilled water
- Concentrated powder dyes, $7 to $10 per oz. wdlockwood.com
  - 1 part medium yellow maple (#142)
  - ½ part golden yellow (MCW #194)
- Dewaxed shellac (sanding sealer), $15 per qt.

GEL STAIN

- Alkyd glaze base 409 $18 per qt. benjaminmoore.com
- General Finishes gel stains $16 per qt. generalfinishes.com
  - 1½ parts thinned glaze base
  - 3 parts Prairie Wheat
  - ¾ part Georgian Cherry
- Softener brush or similar soft-bristled brush

VARNISH

- WoodEpox, $21.50 abatron.com
- Dry pigment (raw sienna) $11.50 dickblick.com
- McCloskey Man O' War gloss spar varnish, 7505 series, $25 per qt. valsparglobal.com
- Plastic-reinforced foam brush, $1

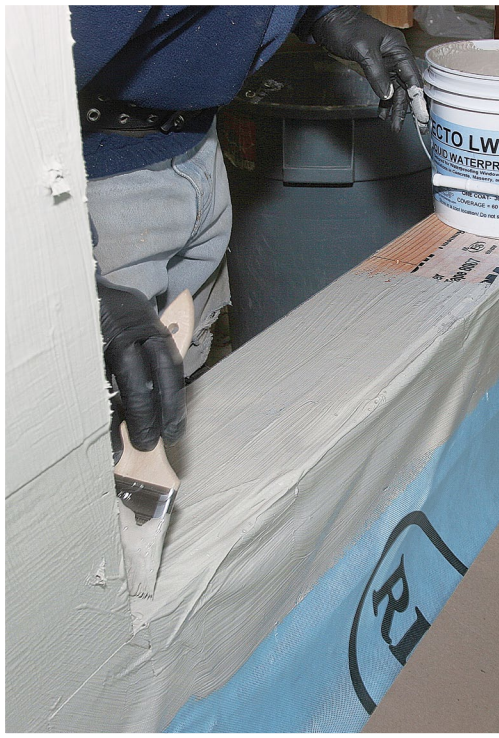
in the finish stay suspended and the resulting sheen is consistent. The directions on the back of a can of McCloskey varnish recommend a minimum of two coats. In my opinion, an exterior door should get at least five coats to start its life.

The finish dries to the touch within six hours, but it's crucial to allow 24 hours of dry time before sanding and recoating. The first coat of this varnish was thin, so I used 320-grit sandpaper to refine it. Anything rougher probably would have cut through and into my color coats. For subsequent coats, I used 220-grit paper for most of the work, only switching to 320-grit paper for the muntins. Besides sanding, I like to refine the surface with a maroon Scotch-Brite pad between coats, being careful not to rub through the varnish at edges and corners.

Don't wait until the varnish is cracked and the wood is discolored to think about recoating. Keep an eye on the finish (gloss coatings that become dull are one indicator), and stay on top of the maintenance. Then when it does come time to renew the surface, it's as simple as washing, drying, scuff sanding, and recoating with more varnish. □

Peter Gedrys is a professional finisher in East Haddam, Conn. Photos by Justin Fink.

Can Liquid Flashing



Residential builders are beginning to experiment with fluid flashing products developed for commercial jobs

BY MARTIN HOLLADAY

By now, conscientious builders know that window and door openings need to be flashed carefully to keep out water. For residential builders, the most common way to flash openings is with peel-and-stick membrane.

However, a growing number of builders are looking at liquid-applied flashings (LAFs). Common in commercial construction, LAFs haven't been seen much in residential work. Their advertised advantages—a small learning curve and fast installation—seem to warrant a closer look. LAFs come in various forms from eight different manufacturers. (Two others, Dryvit and VaproShield, make LAFs but require them to be used only as part of a proprietary WRB system. A third, Dow Corning, says that its product "isn't designed for use in single-family residential construction.") Some products are dispensed from cartridges like caulk; others come in a pail and have the consistency of mayonnaise.

Application is simple

All LAFs share the base chemicals used in the manufacture of caulks and sealants. Most are formulated from silyl-terminated polyether (STPE), but some, such as Pecora XL-Flash, are formulated from silyl-terminated polyurethane (STPU).

Once cured, they form a rubbery layer that manufacturers claim to be waterproof and airtight. Unlike most peel-and-stick flashings, most LAFs are vapor permeable; when used on the exterior side of wall sheathing, they won't create a wrong-side vapor barrier.

Builders have discovered that liquid flashings work particularly well with inset windows. They don't require any tricky origami at corners, and they avoid the problem of thick buildup caused by multiple layers of folded peel-and-stick.

To use an LAF, you squeeze or spread a generous amount on the surfaces that need flashing—generally the rough sill, the rough jambs, the head, and a 6-in.- to 8-in.-wide band of the sheathing around the opening—and then you spread the material out with a trowel or a plastic spreading tool. Some products have a thinner consistency and are brushed or rolled on (a few can be sprayed). Most manufacturers advise using enough material to make an opaque layer. LAFs can also be used to flash pipe and wire penetrations through wall sheathing. Application is easy and fast. If you make a mistake, just spread on a little more material.

Most manufacturers claim that their products stick tenaciously to plywood, OSB, framing lumber, concrete, CMUs, brick,

Replace Tape?

Brush-on membrane speeds window flashing. *In most cases, a mechanical connection such as flashing tape is used to bridge the rough opening and the housewrap. LAF application methods vary, with some products brushed on (shown) and others applied with a caulk gun or sausage gun and then troweled smooth. The big advantage is in the corners, where the liquid membrane replaces the origami of several flashing-tape layers. At the end, the unit is installed and integrated with the WRB normally.*

aluminum, painted steel, vinyl, rigid foam, glass, and EPDM. Some manufacturers warn that their products don't stick to housewrap, however.

LAFs have a few disadvantages for residential builders. For one, they may not be available at local building-supply stores. That may be because most of these products are marketed toward the commercial construction market and so aren't readily found in residential distribution channels. Another problem is that most of these products are difficult to integrate with housewrap.

A 5-gal. pail of Dow LiquidArmor can be purchased on the web for $263 ($53 per gal.). Mike Stout of Protecto Wrap reports that retailers are charging between $35 and $50 per gal. for his company's LWM200 LAF. That's around $1 per sq. ft., similar in price to many peel-and-stick membranes.

"It's not really more expensive than using peel-and-stick flashing," Stout claims. "On concrete block, you need a primer with any peel-and-stick. OSB also requires a primer, which adds material and labor cost. The advantage of a liquid is that it can be painted on by anybody. Tell the guy, 'Cover it com-

LIQUID-APPLIED FLASHINGS AT A GLANCE

There are more LAFs on the market than are shown here, but only these have been approved by their manufacturer for use with regular housewraps. The others aren't approved for residential use or are intended to be used only with the manufacturer's proprietary WRB system, even though their chemistry is similar.

Henry Air-Bloc LF
Application method: Trowel
Sold as: 20-oz. sausage
Lowest application temperature: 20°F
Crack bridging: Fill cracks larger than ¼ in. with Air-Bloc prior to coating
Perm rating: 21.8
Application thickness: 25 mils
Base material: STPE

Prosoco FastFlash
Application method: Trowel
Sold as: 20-oz. sausage and 28-oz. cartridge
Lowest application temperature: 40°F
Crack bridging: Cracks larger than 1 in. require structural repair
Perm rating: 21
Application thickness: 12 to 15 mils
Base material: STPE

Pecora XL-Flash
Application method: Trowel
Sold as: 20-oz. sausage
Lowest application temperature: 20°F
Crack bridging: Cracks wider than ¼ in. require reinforcing mesh
Perm rating: 21
Application thickness: 30 mils
Base material: STPU

Sausages and sausage guns

In commercial construction, sealants and liquid-applied flashings commonly come in packs of sausages—that is, 10-oz. or 20-oz. tubes wrapped in thin plastic. They're applied using sausage guns, which bear as much resemblance to an automotive grease gun as they do to a standard caulk gun. Sausage guns are pricier (the one shown here costs about $40), exert more pressure for faster application than do caulk guns, and come with application tips of a variety of shapes. As with a grease gun, you unscrew a cap, open the sausage and drop it in, and then screw the cap back on.

pletely,' and then just come back later and see if he did it right. You can always roll on some more. The savings come on the labor end."

Cold-weather application of most LAFs is problematic. Typically, manufacturers require temperatures to be at least 32°F and rising, and with no visible frost. Some manufacturers want the temperature to be even warmer; Prosoco FastFlash can't be applied at temperatures below 40°F. Cold-climate builders might choose DuPont Tyvek Fluid Applied Flashing, which can be installed at temperatures as low as 25°F, or Pecora XL-Flash, which can be applied at 20°F.

Most LAFs work with housewrap

Some manufacturers of LAFs won't stand behind their products unless they are used as part of a proprietary liquid-applied water-resistive barrier (WRB) system. When asked whether Dryvit's LAF can be used with regular housewrap, Roland Serino, a representative for the company, told me, "We don't actively market AquaFlash Liquid as a stand-alone product. The only warranties we have are for when it is used as part of our air-barrier system or EIFS [exterior insulation and finish system]." Kevin Nolan, a technical director at VaproShield, gave a similar response: "We do not recommend VaproLiqui-Flash for use except for part of the system." I couldn't get a clear answer regarding Henry Air-Bloc LF from the Henry Company representative.

At the other end of the spectrum were DuPont, Huber Engineered Woods (maker of Zip System products), Pecora, Prosoco, Protecto Wrap, Sto, and W.R. Meadows.

Stout of Protecto Wrap says that his company's LWM200 is "a stand-alone product," meaning that it can be used with a variety of different WRBs. "We developed it for window and door applications," he explains. "It's especially good for recessed window openings or retrofit windows, or concrete-block walls with a wood buck." Paul Grahovac, a Prosoco representantive, says that his company's LAF, FastFlash, can be used with ordinary housewraps.

Russ Snow at W.R. Meadows says that his company's product, Air-Shield Liquid Flashing, "could go with other systems." I asked him whether there were any common building materials that this type of flashing is not compatible with. "Not that we have discovered so far," he answered.

Some manufacturers insist that their flashings be protected from the weather after 30 days. By contrast, Zip System Liquid Flash can be exposed to the weather for up to six months. Protecto Wrap LWM200 and

Photos this page and facing page: Rodney Diaz

Prosoco FastFlash can be left exposed for up to a year.

Integrating LAFs with housewrap

Most products require some type of flexible flashing to make the transition from the LAF to the housewrap. DuPont's James Katsaros says, "We like to use a transition membrane like a 4-in. peel-and-stick flashing tape [to connect housewrap to LAF] at the rough sill, because the housewrap and the fluid-applied flashing don't form a stable interface." Protecto Wrap's Stout says, "For window rough openings, we recommend that you install one of our peel-and-stick flashing products on the sill. Then you can paint over the top with an LAF."

Prosoco's Paul Grahovac notes that transitioning from Tyvek to an LAF can be tricky: "You can't put any of our products on Tyvek except AirDam [a sealant]. You spread the AirDam with a tool so that it's like a coating."

Because using an LAF with ordinary housewrap may require a transition sill flashing, choosing Zip System sheathing with its integral WRB might make sense. All you have to do is spread Zip System Liquid Flash in the rough openings and you're done.

How thick?

Most manufacturers recommend that LAFs be applied at 12 mils wet thickness, but some need to be applied at 20 mils or 30 mils. Read the label to determine how thick it should go on. Use a mil gauge if you have any doubts.

"It's important to use the right amount, but I don't think you screw it up by putting it on too thick," Allen Sealock of Huber says. "As long as you get it on so that you achieve an opaque coverage, then you know you have the amount you need."

Mike Murphy gives this advice to anyone who installs Pecora XL-Flash: "When you spread it, fill the peaks and valleys. Butter it on until nothing is protruding and there are no holes."

LAFs can take a few minutes to an hour or more to dry tack free. Wet-setting windows or doors can be messy. Spreading LAF on all the openings and then returning to the first one to install the unit mitigates this problem.

I tested seven LAFs informally. None remained waterproof under a puddle of water on a horizontal surface similar to a rough window sill. That finding raises caution flags, but sloping the rough sills may be sufficient to avoid puddling. After early adopters share the results of a few years of job-site experience, residential builders will have a better idea of whether or not it's time to abandon peel-and-stick flashing. □

Senior editor Martin Holladay runs *Fine Homebuilding*'s sibling, GreenBuilding Advisor.com, from which this article is adapted. Photos by Andy Engel, except where noted.

A Closer Look at Solid-Wood Flooring

The ins and outs of an enduring favorite

BY ANATOLE BURKIN

Solid-wood flooring has enjoyed a reputation for durability and beauty for centuries. Many older homes sport original flooring that's still in excellent condition after enduring generations of activity. With traffic and time, a wood floor develops a character and charm that's hard to beat, making it a perennially popular choice.

Whether the flooring is new or reclaimed, domestic or imported, wood offers an almost unlimited variety of finishes and can be sanded and refinished several times over its life span. The finish can simply draw out the natural character of the wood, or in the case of dye, stain, or pickling, it can color the wood. Depending on how it was cut, it can range from mild to wild in appearance. The surface can be sanded smooth (no "crumb catchers" in the kitchen), or it can be left with or given a rustic and textured look. In residential construction, solid-wood flooring is used extensively, especially in higher-end homes, because of its many creative installation possibilities, its long life span, and its purity.

In the April/May 2015 issue of *Hardwood Floors* (the magazine of the National Wood Flooring Association), contractors reported that red oak had 43% of the U.S. market, followed by white oak at 26%. According to the NWFA, traditional 2¼-in. red-oak strip flooring is still the favorite, but there's been a trend toward wider and longer planks and toward random-width installations (a mix of 3-in., 4-in., and 5-in. planks). Also, gray colors are currently popular, as are highly figured woods containing mineral streaks, prominent grain, and knot holes.

More imported species are coming to market as well, most of them tropical woods. Flooring companies sometimes like to give them common names, but American cherry has about as much in common with Brazilian cherry as an old fashioned does to a caipirinha. Both are fine choices but wholly different flavors.

Properties and parameters

In the marketing of flooring products, you may see the phrase *solid wood* to describe materials that contain real wood layered onto processed substrates; that product is known as engineered flooring. Solid-wood flooring as discussed here consists of 100% real wood with no substrates.

Solid-wood flooring for residential construction is typically ¾ in. thick, with tongue-and-groove joints along the edges. It can be refinished (sanded and

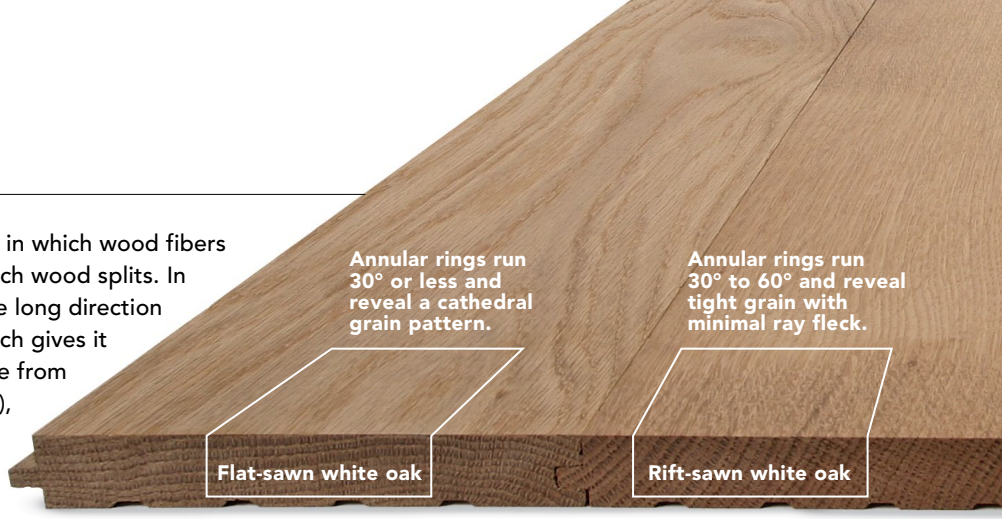
Photo: Susan Teare

Stunning variety. *Unlike a prefinished floor, where beveled edges disrupt the surface and gather dirt, unfinished solid-wood flooring can be sanded flat. This makes it possible for different lighting conditions to draw out a floor's dynamic characteristics, such as with this quartersawn white-oak floor.*

KNOW THE LINGO

The terms *grain* and *figure* are often used interchangeably, but there is a difference. Figure is the more important of the two because it describes the most visible features of wood aside from color. When examining flooring, ask questions about how uniform or varied the wood's appearance will be from one board to the next. Flooring samples can appear remarkably uniform, but a larger presentation of the product has a far greater range of figure and color. It helps to know some of the basic terminology used to describe wood and flooring. Here's a quick guide.

GRAIN Grain is the path in which wood fibers flow, the direction in which wood splits. In flooring, grain runs in the long direction of the strip or plank, which gives it strength. Grain can range from *open* (visually prominent), as with oak, to *closed* (visually subtle), as with maple.



CHARACTER The term *character* is sometimes used to refer to the presence of figure, grain, and defects. For example, salvaged lumber—with lots of pattern variation (figure), prominent growth rings (grain), and nail holes (defects)—may be described as having a lot of character. Depending on your taste, wood with character might look like junk or treasure.

COLOR There are two aspects to color: the natural color of a type of wood and the stain or dye applied to it during finishing. Stains have pigment, and that pigment lodges in the pores of the wood, making for dramatic patterns. Dyes are more uniform and so tone the wood more evenly. Sometimes both are used. These are aesthetic choices, and more of them are available when working with unfinished flooring.

coated) four or more times before needing replacement. The sanding process removes approximately 1⁄16 in. of material. Because the solid-wood layer is thinner on most engineered products, it is likely that it can be refinished only once or twice.

Brett Miller, vice president of education and certification at the NWFA, explains how a solid-wood floor can last for such a long time: "Aesthetically, the thickness of a floor makes no difference at all. Once it's installed, you won't be able to tell. The thickness of the wood above the tongue, however, will ultimately determine how many times the floor can be sanded and refinished during its service life. When properly maintained, wood floors can last for hundreds of years, and if repairs or sanding are required, a wood-flooring professional will remove only a small fraction of the actual flooring material. The thicker the flooring above the tongue, the more times this can happen."

Al Dobrin, sales manager and director of Amber Flooring, a custom residential and commercial flooring company in Emeryville, Calif., says that thinner material is typically used when matching a new floor to an existing floor that has been sanded down in thickness. However, the amount of material below the tongue must match the existing floor so that the replacements do not ride above the subfloor.

With solid wood, you gain the assurance that dings and scratches will still look natural and add character, in contrast to an engineered product that, if damaged to the core, will have a different color and texture than its surface.

Wood grain and movement

Even after wood has been cut and dried, the material will swell and shrink with changes in temperature and humidity. That's because the cells of wood are like sponges, absorbing and releasing water vapor, depending on atmospheric conditions. Floor finishes have only some vapor-retarding capability, and of course, the flooring's underside is unfin-

Top photo: Rodney Diaz (oak samples milled by Riverbend Wood Floor Co., Ridgefield, Conn.)
Bottom photos, from left to right: Aaron Fagan, Charles Bickford, and Susan Teare.

FIGURE Figure describes the patterns in wood, many of which are unique to a particular species. Examples are ray fleck in quartersawn white oak, quilted patterns in maple, and ribbon shapes in mahogany. Not all woods exhibit dramatic figure, and it can vary greatly depending on how the wood is cut. Natural color variations within a wood such as hickory can produce what's called pigmented figure.

TEXTURE The oldest wooden floors were smoothed with hand tools, which left behind tool marks. During the Industrial Revolution, machines made smooth, flat floors easy to produce, so they became the norm. Today, texture choices include "hand-scraped" (usually done by a machine), smooth, and wire-brushed. At left is an example of hand-scraped maple.

GRADE Wood is graded for quality with the terms *clear, select,* and *common*. Clear is the highest grade, and select has fewer of the defects, such as knots and sapwood, found in common wood.

FINISH Most prefinished floors come with a topcoat that contains aluminum oxide, which toughens the finish. On-site finishing offers durable choices (see "Choosing the right finish," p. 52), but none can match a factory-applied finish. However, a prefinished floor has beveled edges where dirt and crumbs can gather.

ished. Floors expand and contract along their width; longitudinal movement is minimal.

In the book *Wood Flooring: A Complete Guide to Layout, Installation, and Finishing* by Charles Peterson with Andy Engel (The Taunton Press, 2010), the authors note the following: "Moisture can cause a wood floor to expand to such an extent that it actually moves the walls of a building. It takes over 1000 lb. per sq. in. to crush the wood cells of a red-oak board, yet many oak floors that have failed because of moisture-driven expansion have permanently crushed boards." That shouldn't turn you away from solid-wood floors. To the contrary, it illustrates how tough solid-wood flooring is.

How much a particular wood moves depends on two things: the individual species and how the material was cut at the mill. The greatest amount of wood movement occurs tangentially to the growth rings, which is how flat-sawn wood is cut. The least amount of wood movement occurs radially to the growth rings, which is how quartersawn wood is cut. How wood has been sawn also affects the grain pattern and figure, important aesthetic considerations when choosing flooring.

For example, for a classic Craftsman-style floor, one might choose quartersawn white oak. Sawing white oak radially exposes a dramatic feature called ray fleck. Quartersawn (also known as vertical grain) wood moves less than flat-sawn, but that's not to say one should avoid flat-sawn wood for flooring. Flat-sawing is the most efficient way to cut a log, minimizing waste and allowing for wider boards. It also reveals pleasing cathedral patterns in the grain.

Installers should check the moisture content of wood before it's installed in accordance with the regional standards set by the USDA's Forest Products Laboratory. Flooring should be delivered a week or more ahead of time, left to acclimate, then installed with ½-in. expansion gaps along the walls. That way, the entire floor can expand and contract freely, like an elastic waistband. In

CHOOSING THE RIGHT FINISH

Tadas Wood Flooring of Naperville, Ill., specializes in refinishing hardwood floors. The company has tested many products over the years and has developed a guide that sheds light on the durability of different types of floor finishes.

	Type of finish	Two-part water	Single water	Oil-based	Swedish finish	Moisture-cure	Penetrating and wax	Hardwax oils
Durability	Wear	5	4	3.5	4.5	5	3	4
	Scratch	4.5	4	3.5	4.5	5	3	4
	Chemical	5	5	4	5	5	2	4
Other factors	Looks	4	4	5	5	5	5	5
	Aging	5	4	3	3	3	5	4.5
	Fumes/odor	5	5	3	1	0.5	3	5
	Maintenance	4	4	4	4	4	3	5
	Time	5	5	4	3.5	3.5	3	5
Totals		**37.5**	**35**	**30**	**30.5**	**31**	**27**	**36.5**

The numbers represent the opinions of the testers and are averages for the product categories. Specific products may perform better or worse. **5** Excellent **4** Very good **3** Good **2** Fair **1** Poor **0** Horrible

new construction, where job sites can be damp from exposure to the elements, it's important that subfloors be allowed to dry and that wood flooring be installed at the very end of the job.

Installation and finishes for solid-wood floors

Despite the limited options, about 70% of consumers now prefer a factory finish, according to the NWFA. There are several reasons for this: Factory finishes are the most durable and come with long warranties, flooring installation is quicker and cheaper, and there is no waiting period while installers go through the time-consuming steps of sanding (which is also dusty) and applying several coats of finish.

For homeowners looking for something more specific, floors finished on-site present endless possibilities. Dyes and stains can be custom blended to match the room's decor or even the existing wood trim or existing floors. Additionally, stencils, decals, and other decorative details can be applied to a floor before the protective topcoat is added.

Ron Cutler, sales consultant and installation manager for The Floor Store in San Francisco, outlines the finishing process his company follows: "For the finish, we typically stain and seal it, then apply two to three topcoats. With water-based finishes, it takes about seven days to fully cure. With oil-based finishes, it can take about a month to fully cure." However, floors can be walked on two days after a water-based finish is applied and three to four days for oil-based.

"When you sand the floor, you end up with a flush edge," Cutler continues. "And any gaps can be filled." That look is not possible with prefinished flooring, where there's a slight "rollover," or bevel edge, between planks as a result of finishing and milling. Also, with prefinished flooring, you have to accept a height variance between planks that's about the thickness of a credit card.

According to the NWFA, water-based finishes are the most popular today, accounting for 51% of all finishes, followed by oil-modified (36%), conversion varnish (4%), oil (4%), and finishes such as wax making up the rest. "Matte and low sheens are the most popular," says Miller.

That said, custom finishes (see "Choosing the right finish," left) such as waxes can give a floor a warm, natural look unlike that produced from a factory finish. According

Photo this page: Justin Fink. Photos facing page: Rodney Diaz.

to Dobrin, "A wax finish can be applied throughout the house, depending on traffic, and on average requires a new coat about every couple of years."

Adam Williams, marketing manager of the NWFA, says, "Durable film-forming prefinish options include moisture-cure urethanes, acid-cure urethanes, two-component waterborne urethanes, UV finishes, and aluminum oxides. Which is more durable is debatable."

A designer's perspective on choosing wood flooring

Yana Mlynash, an interior designer from Mountain View, Calif., takes a logical approach with her clients when it comes to remodeling. "I always pick cabinets and countertops first and then move to floors," she says. "It's not that hard to eliminate the flooring options since many times it's about price, what is already in the house, and what is best for the family's situation."

But there's more to consider than simply the final product. Some families need a highly durable material (see "What's hot under your heels," right) for children and pets. Mlynash says, "You want to look at the hardness level of the floor." Oak and hickory do an excellent job of hiding scrapes and dents, especially when the flooring is salvaged.

In a remodel, choices may be limited if you prefer continuity throughout the house. "Many homes, at least in Northern California, have oak flooring," Mlynash says. "In order to not rip out the entire house, many clients choose to match the floor and sand and finish the entire house. This removes all the spotting from furniture or carpets and gives you the option of going lighter with a new stain," she said.

Unlike carpet, which can be difficult to keep totally free of mold, mildew, and dust mites, wood flooring comes clean with less effort. "Wood floors are very good for your health," says Mlynash. "They are softer than tile and easier to clean than carpet."

Shopping for flooring is a bit like buying clothes for an outfit: You need to think about how it ties together and maintain age-appropriateness. In terms of a house, that means choosing a floor durable enough to meet the tastes and tests of time, which is why solid-wood flooring is here to stay. □

Anatole Burkin is a freelance writer in Santa Rosa, Calif.

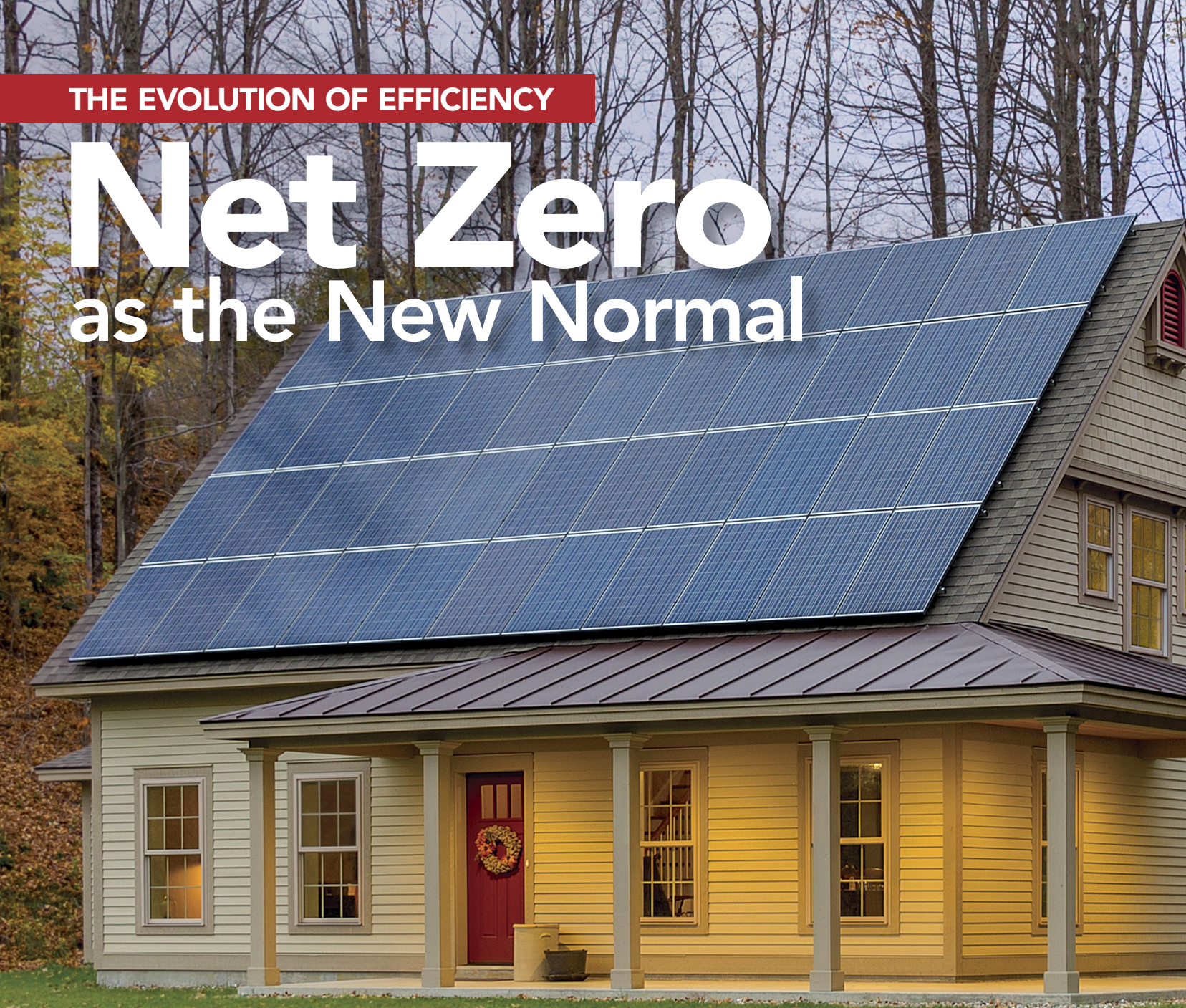
WHAT'S HOT UNDER YOUR HEELS

In the United States, domestic species are by far the most commonly chosen woods for flooring. The oaks still rule, followed by maple. Among imported species, Brazilian cherry is the most popular. Below is a list of woods that details their popularity and where they are situated on the Janka hardness scale, which measures the force required to drive a 0.444-in. steel ball into the wood until half its diameter is embedded.

Source: Survey of flooring contractors as reported in the April/May 2015 issue of *Hardwood Floors*, the magazine of the National Wood Flooring Association.

THE EVOLUTION OF EFFICIENCY

Net Zero as the New Normal



Experimentation and learning have led one builder to integrate energy-smart techniques into everyday construction

BY MARTIN HOLLADAY

Biologists note that when unrelated species occupy the same environment, evolutionary changes sometimes alter those species in similar ways. After millions of years, a swimming bird like a penguin, a swimming mammal like a dolphin, and a swimming fish like a shark tend to resemble each other: They all have sleek, smooth bodies and propel themselves with similar motions. This is an example of convergent evolution.

A parallel example is becoming evident in the world of residential construction. In New England, builders who have been paying attention to energy issues for the last 20 years and a subset of builders who attend conferences and constantly push their techniques to the next level are beginning to exhibit signs of convergent evolution. As these forward-thinking builders learn new concepts, experiment with their implementation, and share their successes and failures with fellow builders, homes they build are beginning to resemble each other. These net-zero-energy homes are often compact two-story designs with the long axis oriented in an east-west direction, and most have triple-glazed windows and walls with high R-values. Increasingly,

Photo this page: Gary Hall. Drawing facing page: John Hartman.

these homes are equipped with roof-mounted photovoltaic (PV) arrays and are heated and cooled by ductless minisplits. Custom builder Paul Biebel, president of Prudent Living Homes in Vermont, is a prime example of this ongoing evolution.

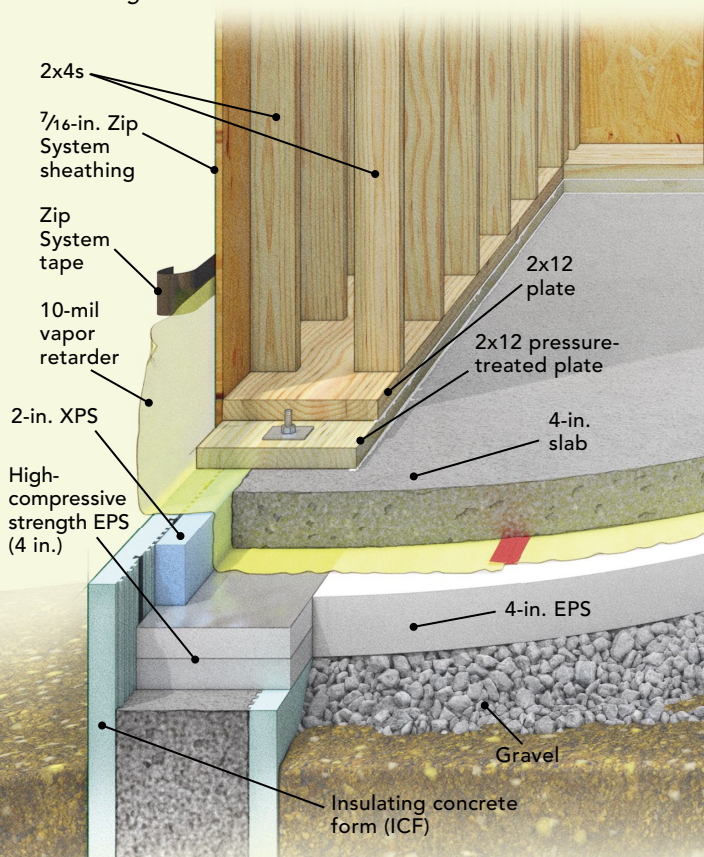
Four decades on the learning curve

The 2500-sq.-ft. house in Norwich, Vt., shown here was completed in 2015, Biebel's 39th year of building houses. "We build five or six custom houses per year, and it's probably been six or seven years since

A SMART SLAB ASSEMBLY

More than a structural base for the house, the stemwalls and slab separate the conditioned living space from the cold earth. Here, the insulation, air-sealing, and moisture-control details all must work together.

ICFs as slab-edge insulation. *By stopping the concrete pour for the stemwalls about 8 in. shy of the ICFs' top edge, the inner flange of the forms can be cut off to make room for a double layer of 2-in.-thick high-compressive-strength EPS foam atop the stemwalls, with 4-in.-thick foam added in the rest of the field. The remaining outer edge of the ICFs provides insulation for the slab edge.*



THICK, TALL WALLS

Arguably one of the simplest and most cost-effective ways to achieve a superinsulated wall, double-stud framing provides an excellent thermal break, especially when combined with the selective use of spray foam. To allow the cavity insulation to run uninterrupted from bottom plate to roof rafters, the framers built balloon-framed walls, then hung the floor system from a ledger.

One on top of the other. *After the interior section of the double-stud wall is assembled, the outer section is framed atop it, with plywood flanges separating the two sections. The entire assembly is sheathed and tipped into place in one piece.*

we've built one just to code minimum," Biebel says. "Nobody likes to be a guinea pig, but we have incorporated new approaches and technology slowly over the years, little by little."

Homeowners who invest in these features from the start, including the incremental costs in a 30-year mortgage, end up with very low energy bills. In fact, these features are often cash-flow positive from day 1. Regarding the cost required to hit this mark, Biebel says, "If you add $30,000 up front to make the upgrades, you will have made that money back in six to eight years, all while having no utility bills." But it's more than avoiding utility bills; according to Biebel, it's about making a smart investment. "To me, this is about preparing for the future," he says. "What is your house going to be worth 10 years from now if it doesn't perform at that level? I see investing in this technology as protecting your investment."

It begins with the shell

Although Biebel's houses are custom, they follow a high-performance baseline. The foundation consists of perimeter stemwalls—insulated concrete forms (ICFs) from Nudura—with an additional layer of rigid foam installed along the outside edge of the slab. A 4-in. layer of foam under the slab is rated at R-20.

Biebel builds two kinds of walls: double-stud walls filled with cellulose (R-45) and 2x6 cellulose-filled walls with rigid foam on the outside (R-40) for clients concerned about interior square footage. At the base of the walls in this house, the sheathing is taped to the 10-mil Stego Wrap vapor barrier that was installed directly under the concrete-slab foundation to create a continuous air barrier up the wall and eventually across the top plate and up the inside face of the roof rafters.

The roof on a Biebel house is at least R-60, even if there's a cathedral ceiling instead of a traditional attic. This high level of insulation is achieved with 20-in.-deep trusses, which allow enough room for 2-in.-deep site-built ventilation channels and 18 in. of dense-pack cellulose. If a more conventional attic is built, Biebel ramps the R-60 minimum to a more robust R-90, simply because the incremental cost is easy to justify when blowing loose-fill cellulose on an attic floor.

Directly above the ceiling drywall on the second floor, a layer of taped Zip System sheathing creates a durable air barrier. This sheathing layer is tied into a layer of self-adhered flashing that crosses over the top plates of the exterior walls and is sealed to the sheathing on the outside face. The insulation follows the roof slope rather than the kneewall, and the drywall air barrier is hung before any kneewalls are framed.

In some places, such as on the breezeway between the house and the insulated garage, spray foam was used to insulate the roof in order to achieve a high R-value in a relatively compact space. In cases like this, Biebel applies a 1-in. layer of rigid foam to the top of the rafters or trusses to create a thermal break. Strapping and plywood are then added over the foam, forming a free-flowing ventilation channel under the roofing. "Although this isn't required with closed-cell foam," Biebel says, "we were informed by our suppliers that the shingle companies do not give a full warranty on any roof that is foamed tight to the underside."

Biebel's blower-door test results (1 ACH50) justify the air-sealing efforts. The crew tests houses after the air-sealing and insulation are complete, and then again when the house is finished. "Our numbers would probably be lower if we could install casement windows," Biebel says. "But all our customers want double-hungs."

Cellulose belt, spray-foam suspenders. *Although primarily insulated with dense-pack cellulose, all penetrations are coated first with spray polyurethane foam, and all seams in wall plates are sealed with a bead of caulk.*

In all of his builds, Biebel uses triple-glazed windows that have a whole-window U-factor of 0.19 and a solar heat-gain coefficient of 0.25. The vinyl windows shown here are Harvey Building Products' Tribute units.

"Harvey only charges $50 per window to upgrade from double to triple glazing; some manufacturers charge an additional $200 per window," Biebel says. "The window package for this house cost less than $10,000, which is half the price of the same package from some other manufacturers."

Inside the tight and well-insulated shell, the focus moves to a successful integration of mechanicals.

Learning to get the most from minisplits

Biebel has been heating and cooling his homes with Mitsubishi ductless minisplits for several years. (For more on minisplits, see "When Ductless Minisplits Make Sense," *FHB* #237.) This house has two outdoor units: one for the ductless units and one for the ducted system. Biebel's cost to install a ductless minisplit in a house with multiple indoor heads is usually between $3000 and $4000 per head. "A ducted system can cost twice as much as a ductless system," he says, "but we do offer it as an option for those clients who don't want to see the minisplit head mounted on the wall."

There is a learning curve to locating minisplits. "You have to think about special conditions," Biebel explains. "A house we built in New Hampshire was located at the end of a long, narrow pond, and the pond created a wind-tunnel effect. We put the outdoor unit under the deck, thinking that it was protected. But the fan and coils got packed with snow. The solution in that case was to move the outdoor unit to the street side of the house."

Noise is also an issue. "There is always some vibration from the outdoor units, so it's important to choose the location carefully," Biebel says. "When things are quiet, you can hear a vibration or hum."

Inside the house, the routes for the refrigerant and condensate lines need to be planned carefully. "In some cases, you may need custom framing to accommodate them," Biebel says. "You need to miss any important timbers or beams. Some homes require 50 ft. or more of

DEEP-TRUSS ROOF

Combining the proven benefits of traditional attic ventilation with superinsulation strategies, these deep trusses yield an R-60 roof and cathedral ceiling by way of some clever site-built details.

Superinsulated, vented cathedral. *The 20-in.-deep trusses provide space for site-built ventilation baffles that are made from ripped 2x stock and ½-in. OSB and are sealed at all joints with canned foam. The remaining 18 in. of space is then dense-packed with cellulose to provide an R-60 lid.*

Air-seal before adding kneewalls. *To provide a reliable air barrier at the ceiling plane, the underside of the roof trusses is covered with Zip System sheathing and seam tape, then covered with drywall before the kneewalls are framed.*

refrigerant line." Condensate lines either can be directed to a leaching system under the slab, or they can go right to the radon pipes, but depending on a trap connected to the DWV system is risky. "When the traps dry out," says Biebel, "you get odors."

The air handler for this house's ducted minisplit is located in a conditioned attic. Although the space is cramped, the HVAC contractor managed to squeeze in the ducted minisplit unit and the Renewaire energy-recovery ventilator (ERV) under the rafters, keeping them inside the insulated envelope to minimize thermal losses.

Mechanical beauty is subjective

As a designer, Biebel prides himself on his attention to integrating ductless-minisplit heads into the interior design of his houses. (The Mitsubishi head in this kitchen is centered over a base cabinet.) "To make a heat-pump head look natural takes a lot of planning," Biebel says. "One thing I've learned is that ugly is in the eye of the beholder. Some people like the minisplit heads, while other people call them ugly. Some people even think solar panels are ugly. Once we were building a house with a solar array, and neighbors stopped by to complain about the solar panels. I replied, 'What if I complained because I thought that your junky vehicles looked ugly?' They got the point and laughed."

The roof-mounted 13kw PV array on this house should produce more electricity on an annual basis than the homeowners need for lights, appliances, plug loads, domestic hot water, space heating, and cooling. "The owners didn't really need 13kw," Biebel confesses, "but

MECHANICALS MAKE IT PAY

When the air-sealing and insulating are done well, the burden on a home's mechanical systems is greatly reduced. Small heating and cooling units are able to condition the home to a comfortable level, and they can be powered by the sun's energy.

Beauty is in the eye of the PV-holder. *Some consider solar panels ugly, but these homeowners increased the size of the PV array beyond their energy requirements for aesthetic reasons, believing the house would look better if the entire roof were covered.*

More than a random placement. *Rough-ins for the minisplit's outdoor units are considered carefully, not only for aesthetic reasons but because they create noise from their vibration.*

they said that the roof would look better if we just went ahead and covered the entire south-facing slope with PV."

Biebel isn't force-feeding solar to his clients, though. "If homeowners aren't interested in going off the grid, or even in adding solar panels, that's OK," he says, "but we plan for that anyway by deciding where the solar inverters would be placed, and we provide conduits from the attic to the basement so that the necessary electrical can be installed without opening walls."

Energy will trump square footage and location

Biebel predicts that the time is coming when energy consumption will be a bigger part of the conversation about house design than location or square footage. "Right now, banks and appraisers only look at square footage and at the value of the house next door," he says. "They'll need to catch up." Biebel has chosen the route of building high-performance homes even though it has meant turning down clients who are interested only in getting the lowest cost per square foot. His reasoning includes equal parts altruism and genuine belief in offering his clients something with lasting value. "I want to put green back in the Crayola box where it belongs," he says. "The only way I see that happening is to make it a normal part of the conversation, not an upgrade." □

Martin Holladay is a senior editor at GreenBuildingAdvisor.com and at *Fine Homebuilding*. Justin Fink also contributed to this article. Photos courtesy of Prudent Living, except where noted.

Prep a Subfloor for Tile

A second layer of plywood stiffens floors for long-lasting tile installations

BY ANDY ENGEL

Start clean. *Scrape up any lumps of dried drywall mud, and sweep the floor clean. Vacuum out the joints in the subfloor and in the corners where the walls meet the floor.*

Fix any problems with the subfloor. *Set any fasteners that stick up, and sand flush any joints with significant lippage. Screw down loose spots.*

Get the layout right. *Run the underlayment perpendicular to the joists, making sure its ends and edges miss the joists and seams in the subfloor by at least 2 in. Mark the joists so that you don't fasten into them. All fasteners should go into the subfloor only.*

As a carpenter, I installed thousands of square feet of plywood underlayment over subflooring that the framers had fastened to the floor joists. Plywood underlayment can be used directly under tile in many instances, and it might still be necessary even if you're using cementboard or one of the plastic isolation underlayment systems. For example, many isolation systems require the use of plywood underlayment with joists on 24-in. centers. These products make great tile bases, but they don't strengthen floors like plywood does. Plywood underlayment helps to share loads between joists, reducing the overall deflection of the floor, and it reinforces the subflooring to stiffen the floor system between the joists. This is important because ceramic tile is pretty inflexible, and movement in the floor below it can cause cracking.

There are three primary sources for correct underlayment details available online, but they don't agree on all points, and some of the details might seem counterintuitive. (For example, underlayment should not be fastened into joists.) When in doubt, consult with the tile manufacturer, who's the one responsible for deciding whether or not to honor warranty claims. For dry areas, or with the use of a waterproofing membrane, the Tile Council of North America's (TCNA) *2015 Handbook for Ceramic, Glass, and Stone Tile Installation* ($29.90 download) lists plywood rated either Exposure 1 or Exterior as a suitable base for floor tile in residential use, with the caveat that it be installed according to details from a different source: ANSI standard A108.01 ($40 download). Another source for information on wood floors is *Ceramic Tile Over Wood Structural Panel Floors* from APA–The Engineered Wood Association (free download).

The TCNA handbook references A108.01, but not the APA's guide. The APA guide references both the TCNA handbook and A108.01. And while the latter two sources require joists spaced on 16-in. centers, the APA has details for joists on 24-in. centers, as well as subfloor and underlayment combinations that the other two don't. The APA claims that its specs meet the TCNA's loading and deflection requirements. Also, in addition to the minimum of

Space the panels correctly. *Space underlayment panels ⅛ in. from each other and ¼ in. from abutting walls and plumbing fixtures. The ends of underlayment panels in adjacent rows should be offset from each other by at least 16 in.*

Fasten it. *Whether you use screws or nails, install them ⅜ in. from the panel edges. Space them no farther apart than 6 in. along the edges of each panel and 8 in. in the field. Narrow the spacing if you aren't using construction adhesive.*

⅝-in. nominal plywood subflooring that the APA references, A108.01 allows underlayment to be laid over nominal 1x6 tongue-and-groove wood-board subflooring, as is common in older houses.

For tile, all the standards agree that the floor needs to deflect no more than L/360 (L = the joist span) under a combined live and dead load of 50 lb. per sq. ft. That spec happens to be the code minimum for living spaces, so most houses built to modern standards are fine. (With older or poorly built houses, it may be worthwhile to get an engineer's evaluation.) The deflection standard jumps to L/720 for natural stone, so you might need to double up the floor joists or seek an engineered solution to install stone to spec in most houses.

All sources call for underlayment to be installed perpendicular to the joists, and the fastening pattern is critical. Don't fasten underlayment to the joists, which can result in fastener pops that detach or break tiles. Nail or screw the underlayment along its edges with at least 4d ring-shank nails spaced at most 6 in. apart. In the field, space fasteners no more than 8 in. apart.

While A108.01 requires adhesive (without specifying type or amount) between the underlayment and the subfloor, neither the APA guide nor the TCNA do. Construction adhesive below the underlayment definitely makes a stronger assembly, but it also makes the work less reversible. In other words, should anyone in the future decide to tear up your floor, they'll have an ordeal on their hands. Because of this, I no longer glue the panels down. Instead, I use more fasteners, reducing the spacing to 3 in. along the edges and 6 in. in the field, and I use screws instead of nails. The screws should be long enough to fully penetrate the subfloor so that enough thread engages the wood to pull the screw heads slightly below the surface of the underlayment. With a typical combined plywood thickness of 1¼ in., use at least 1½ in. screws.

Senior editor Andy Engel built and remodeled houses in New Jersey before joining the *Fine Homebuilding* staff. Photos by Rodney Diaz.

Tool Test

Rotary Hammers

A seasoned remodeler looks for the perfect concrete drill

BY MARK CLEMENT

As a home-improvement contractor, I use my 1-in. rotary hammer all the time. For starters, it's the perfect tool to drill holes for fastening all kinds of things to concrete and masonry—everything from bottom plates and 2x nailers to storage shelves and hose reels. I also use it for chain-drilling a ring of small holes when I need to make a really big hole, such as one for running a 4-in. duct through a stone or block wall for a dryer or bathroom vent.

Rotary hammers are also great for chipping. In fact, a rotary hammer equipped with a 1-in. chisel is the ideal setup for separating tile from a mud-bed or wood subfloor. It's also great for widening an existing hole in concrete, such as for a basement sump pit. And it is beyond handy for digging holes. I regularly use mine for breaking up and prying out stones for deck footings, and for breaking concrete and digging when I'm working on underslab plumbing.

I recently tested seven rotary hammers head-to-head. I chose the SDS-plus 1-in. size because for a remodeler, it's a perfect fit for most tasks. Although too small for major demolition, these tools will drill small-diameter holes and chip tile all day long. They are also surprisingly affordable. The models I tested range in price from about $170 to about $330.

This class of rotary hammer is sold in two styles: pistol grip and D-handle. I prefer the pistol-grip style because it's more compact and more comfortable to use one-handed. Bosch, DeWalt, Hilti, Makita, and Metabo submitted pistol-grip models for the test. Hitachi and Milwaukee don't offer a 1-in. pistol-grip model, so they sent their D-handle equivalents.

Fast concrete drilling

Once you use a rotary hammer for drilling small holes in concrete and masonry, you'll be hard-pressed to go back to the howling whine of a hammer drill (see "What's the Difference?" *FHB* #254). Although there are notable differences among the models in this test, there really isn't a bad tool in the bunch. All drill holes in concrete like they're supposed to. They are also nicely balanced and feel good when held in both typical and awkward positions. After drilling, my fellow testers and I drove concrete screws into the holes to see if there was any bit of wobble that might enlarge the holes and affect the screws' grip. Every screw held tight.

As a speed test, we weighted each tool with a 10-lb. sandbag, then used it to drill two 5⁄32-in. holes in a factory-made concrete paver. The Milwaukee stood out

Three classes of rotary hammer

By Patrick McCombe

Choosing a rotary hammer can be confusing. In addition to the three basic classes of the tool, there are several models within each class. Class is based on the size of bits and chisels. More specifically, it's the size of the shank that fits into the hammer's quick-release chuck. The smallest and most common size for residential work is SDS-plus. Made for chipping and drilling relatively small holes, SDS-plus tools are inexpensive.

The next class is SDS-max, which includes considerably larger tools that can drill holes more than 2 in. wide with a twist-style bit and up to several inches wide with a core bit (essentially a hole saw for concrete). In addition, SDS-max hammers can run larger chisels and other useful accessories ranging from ground-rod drivers to small tampers.

The largest class of rotary hammer is the spline style. Tools in this class are primarily used in commercial work and offer the largest hole sizes and chisels.

Within the three classes, there is an even greater breakdown in the size of tools and the size of holes they can drill. In the case of a 1-in. rotary hammer, *1-in.* refers to the maximum size hole the hammer can drill with a conventional twist-style bit. (Regularly using a rotary hammer at its maximum hole size will quickly wear it out.) Rotary hammers are also rated by their optimal hole size. In the case of the 1-in. tools tested here, most have an optimal hole size of 3⁄16 in. to 5⁄8 in. The Hilti, which is slightly smaller than the others, has an optimal size of 3⁄16 in. to ½ in. When you're considering a rotary hammer, choose a model that's rated for the holes you regularly drill. For light residential work, an SDS-plus model works fine for most things. If you'll be using a rotary hammer primarily for breaking concrete and drilling holes larger than 1 in., choose an SDS-max or spline model. Keep in mind that all types of rotary hammers can be found at rental yards. SDS-plus models run about $40 per day. SDS-max and spline models run about $65 per day.

Patrick McCombe is an associate editor.

with a nearly 2.5-second lead over the slowest tool, the DeWalt. However, I don't think a speed test is indicative of a rotary hammer's overall performance. The reality of residential work is that you drill a few holes at a time, then put the tool down; you're not building a stadium with a million holes to drill for seating. Our aim with the speed test was to see if there was an underperformer in the lineup. There was not.

It is rare in remodeling jobs for me to drill much larger than a ¾-in. hole through a wall. But a 1-in. hole for a new gas pipe or conduit is necessary on occasion, so we chucked up 1-in. bits and went for broke. The Bosch and the Makita punched hard, delivering smooth operation with little torque transferred back to the user. They also had minimal vibration, which kept our hands from buzzing afterward. The Metabo seemed to labor during this test, and the Hilti, which admittedly is the smallest tool of the bunch, was a middle-of-the-road performer. The Hitachi and Milwaukee vibrated more than the others but also delivered fast, consistent drilling.

Chipping and breaking

Whether it's separating tile from whatever's underneath it or pounding off the edge of a rock that won't clear out of a post hole any other way, chipping is an important task for a rotary hammer. The Bosch and the Makita performed the smoothest, and we were able to take surprisingly large chunks off the edge of a sidewalk slab. The Milwaukee and the Hitachi exhibited the most vibration from the tool body right on through the side handle. The DeWalt seemed to vibrate only through the side handle, which was peculiar, but it otherwise was a good performer. The Hilti has no chipping function, so it sat out this test.

Controls and kit boxes

Except for the Hilti, all the tools have at least three settings: drill only, drill and hammer, hammer only. The Bosch, the Makita, and the Milwaukee also have a fourth setting that enables you to position the chipping iron. Pulling the trigger causes the iron to rotate slowly to whatever position you want. This lets you get the chisel in the right position without resorting to bumping the tool's trigger several times. Some of the hammers have a trigger lock. I prefer not to have one because it can be too easy to engage inadvertently.

I think a functional kit box for carrying all the bits and chisels is a key component

HOW WE TESTED

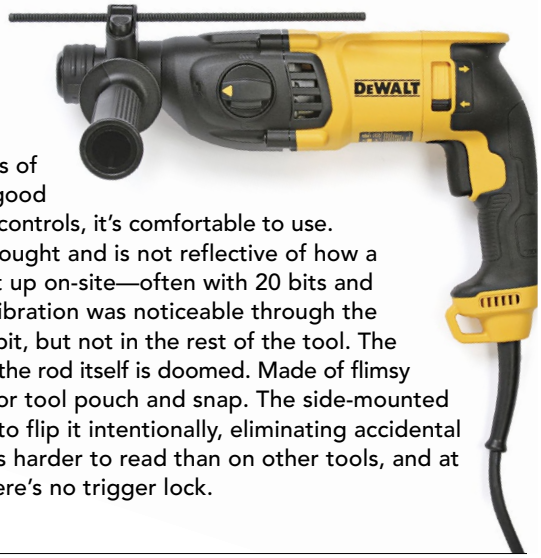
To test these rotary hammers, we drilled hundreds of holes into concrete—both straight down and out front, simulating what it's like to attach a deck ledger to a concrete wall. For consistency, we included a speed test using a 10-lb. weight instead of muscle power. And just to be mean, we installed a 1-in. bit and repeatedly buried it in 4 in. of concrete. We also spent hours chipping concrete at a low angle and then straight down like when you're enlarging a sump pit.

BOSCH 11253VSR

Seconds to drill a 5/32-in. hole in concrete: 5.6
Warranty: 1 year **Price:** $215

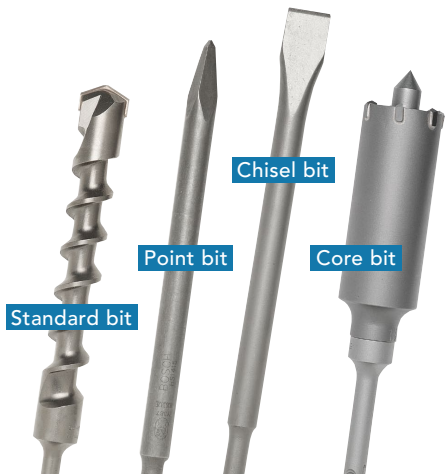
This tool is a sweet blend of all the things a rotary hammer needs to do in unforgiving places. It has minimal vibration and good balance. It excels at simple tasks such as drilling pilot holes for concrete screws, but it also can chip concrete and hog out large holes when necessary. Its well-designed kit box has compartments that keep the tool and bits separate. At 101 in., the cord allows a good deal of freedom of movement. It also coils easily, which makes closing and latching the box a simple task. The tool doesn't have a trigger lock, which is sometimes easy to engage by accident. The depth rod is steel, and the quick adjustment is easy to use. The chisel adjustment setting is a great feature, and the markings on the function dial are easy to read.

DEWALT D25133K



Seconds to drill a 5/32-in. hole in concrete: 5.9
Warranty: 3 years **Price:** $175

This tool performed well in all aspects of drilling and chipping. Because of its good balance and the sensible layout of its controls, it's comfortable to use. Its box, however, feels like an afterthought and is not reflective of how a rotary hammer is transported and set up on-site—often with 20 bits and some grease rattling around. Some vibration was noticeable through the side handle while drilling with a 1-in. bit, but not in the rest of the tool. The depth-rod adjustment works fine, but the rod itself is doomed. Made of flimsy plastic, it's sure to catch on a ladder or tool pouch and snap. The side-mounted forward-reverse button requires you to flip it intentionally, eliminating accidental direction changes. The function dial is harder to read than on other tools, and at 93 in., the cord is relatively short. There's no trigger lock.



A BIT ABOUT BITS

The many sizes and styles of bits and chisels give a rotary hammer its versatility. Point bits are meant for starting holes in concrete or creating spots for a larger chisel to get a good bite. Chisel bits are used for breaking up concrete and masonry and for removing tile. Core bits can drill the largest holes.

Bottom photos, this page: Scott Phillips

MAKITA HR2611F

Seconds to drill a 5⁄32-in. hole in concrete: 4.7 seconds
Warranty: 1 year **Price:** $180

The Makita is sufficiently balanced and agile to hold out front for mounting everything from a TV bracket to deck ledgers, but it still has enough mass for effective chipping straight down and at low angles. It also has plenty of power for drilling larger holes. Its cord is 160 in. long, and its function dial is easy to adjust and to read. The forward-reverse switch requires you to manipulate it intentionally, making an accidental direction switch nearly impossible. The solidly built kit box has sensible compartments that separate the bits from the tool, making it easy to coil the cord and latch the lid. The trigger lock doesn't engage accidentally, and it works easily when needed. The chisel adjustment setting is a valuable addition to the tool.

AUTHOR'S BEST OVERALL CHOICE

Smooth power delivery, good balance, and intelligent controls make the Makita our favorite.

HITACHI DH24PF3

Seconds to drill a 5⁄32-in. hole in concrete: 5.1
Warranty: 1 year **Price:** $169

This D-handle tool with a 156-in. cord worked hard in all our tests. It bored 1-in. holes and chipped with the best of them. It vibrated more than the best-performing pistol-grip tools, but it's also the most affordable tool in the lot. The forward-reverse switch is located near the trigger and is easy to use, but not so easy that you're likely to change direction accidentally. Although its plastic depth rod (like the DeWalt's) is sure to break, the handle where it attaches is sturdy and easily adjusted. The hard-sided plastic box is sensibly designed for tool and bit storage. However, the clasps are less rugged than others in the group. The function dial, which is mounted underneath the housing, has black-on-black markings that made it the hardest to read. The trigger lock caused no problems or accidental turn-ons.

AUTHOR'S BEST VALUE CHOICE

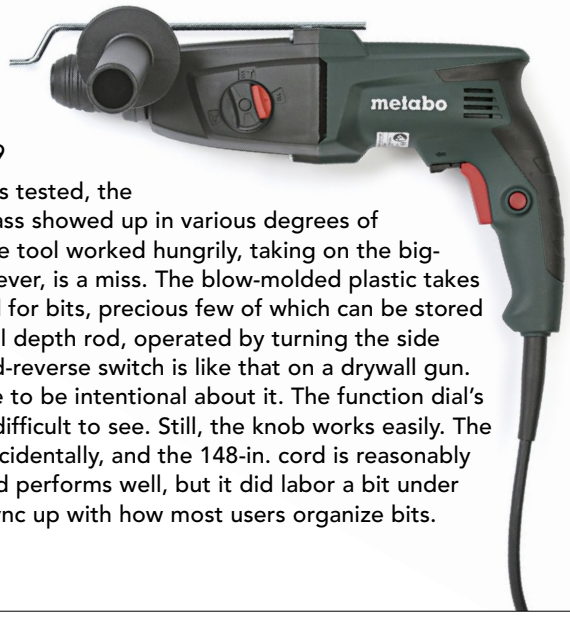
The Hitachi is a workhorse that did everything we wanted it to do quite well.

HILTI TE2

Seconds to drill a 5⁄32-in. hole in concrete: 4.5
Warranty: Lifetime **Price:** $326

If all you do is drill and hammer, this is a comfortable, low-vibration tool. But it doesn't chip. For a premium cost, it's hard to justify losing an important function. While the tool drilled well with small and large bits and is well balanced for driving holes laterally or straight down, its performance isn't as good as its price tag is high. The function icons are easy to read, and the side-mounted function dial makes it easy to change settings. The depth rod is steel and adjusts with a twist of the side handle. The trigger lock is easy to engage but is still flush with the pistol handle, so it's hard to activate accidentally. The forward-reverse switch requires you to change it intentionally. At 152 in., the Hilti's cord is among the longest. The tool itself drills great, but at $100 more than its nearest competitor and without a chipping function, it's overpriced.

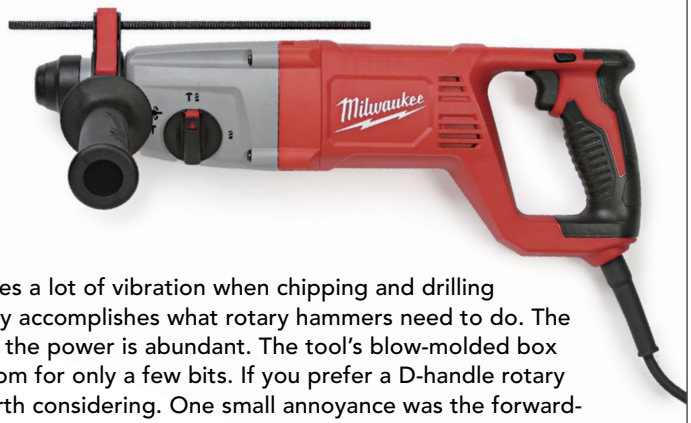
METABO KHE 2444



Seconds to drill a 5⁄32-in. hole in concrete: 5.5 seconds
Warranty: 3 years **Price:** $199

The most compact of all the tools tested, the Metabo's comparative lack of mass showed up in various degrees of vibration across all tasks. Still, the tool worked hungrily, taking on the big-bit test serviceably. Its box, however, is a miss. The blow-molded plastic takes up room that should be reserved for bits, precious few of which can be stored with the tool. The hammer's steel depth rod, operated by turning the side handle, works easily. The forward-reverse switch is like that on a drywall gun. It's easy to engage, but you have to be intentional about it. The function dial's black-on-black markings can be difficult to see. Still, the knob works easily. The trigger lock can't be engaged accidentally, and the 148-in. cord is reasonably long. The Metabo is compact and performs well, but it did labor a bit under duress, and its kit box doesn't sync up with how most users organize bits.

MILWAUKEE 5262-21



Seconds to drill a 5⁄32-in. hole in concrete: 3.6 seconds
Warranty: 5 years
Price: $179

This D-handle unit produces a lot of vibration when chipping and drilling with large bits, but it easily accomplishes what rotary hammers need to do. The fit and finish are nice, and the power is abundant. The tool's blow-molded box has robust buckles but room for only a few bits. If you prefer a D-handle rotary hammer, this model is worth considering. One small annoyance was the forward-reverse switch, which is mounted on the trigger handle. I found that it's a little too easy to knock the tool into reverse inadvertently. Also, at 91 in., the cord is the shortest of the bunch. On the plus side, there is no trigger lock, the chisel adjustment setting is great, and the depth rod is much better than that on any of the other tools.

of a rotary hammer. Metabo's and DeWalt's blow-molded boxes land in the "What were they thinking?" department. Neither has a dedicated space for bit storage, and the recessed areas that are included are too small for bits.

The other boxes all had decent bit storage. Bosch's and Makita's were the best, with channels to drop the bits in that keep them separate from the tool. Hilti's bit storage was nice also, but the kit box itself seems flimsy and is too easy to open upside-down (spilling the contents) because the latches are hinged at the top. Hitachi's bit storage is good, but the case's plastic latches feel like they won't last long. Milwaukee's box is tough, and the bit storage is sensible.

The bottom line

For some tasks—such as working directly over a hole or for repeated straight-down drilling—the longer body of the D-handle Hitachi and Milwaukee hammers is an advantage. Generally speaking, though, the pistol-grip tools ran smoother and were more comfortable to use. They're also more compact, which comes in handy when you're working in tight spaces.

The pistol arrangement also worked better at a low angle, which is the way you would use a rotary hammer for chipping up tile. I found that I could keep my trigger arm farther in front of me, causing noticeably less fatigue than when I used the longer D-handle tools, which forced me to spread out my grip.

Its well-designed box, smooth power delivery in all functions, good balance, intelligent controls, and long cord make the Makita my favorite. Bosch is a close second for all the same reasons.

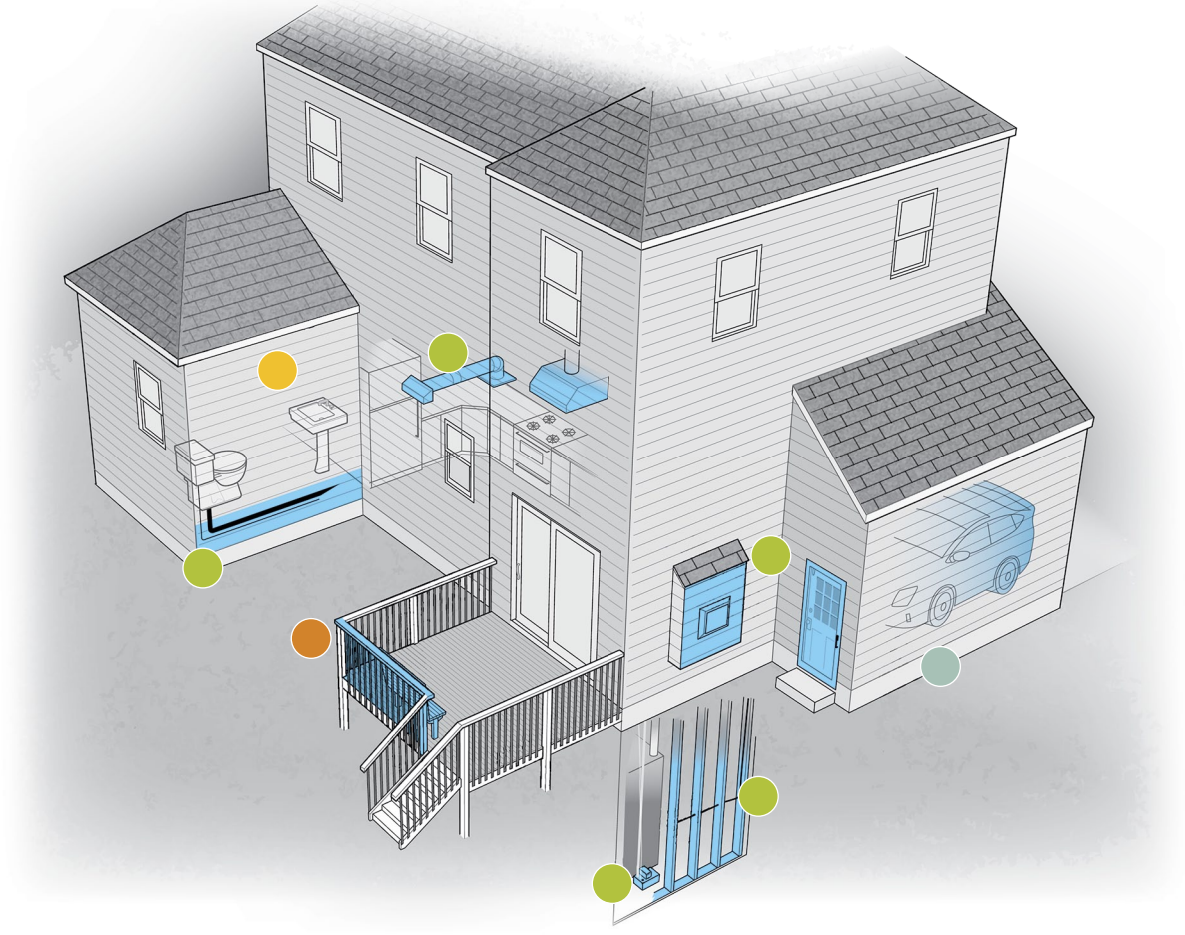
Hand-buzzing vibration and minimal kit box aside, the Hitachi, with its surprisingly long cord, is a workhorse that did everything we wanted it to do quite well. Because it's the most affordable tool in the group, it gets my pick for best value. □

Home-improvement contractor Mark Clement is co-host of the *MyFixitUpLife* show. Andy Doyle, Matthias Lowjewski, and Derek Schroeder of the Bucks Mont chapter of the National Association of the Remodeling Industry (NARI) contributed to this article. Irwin provided new bits for testing. Photos by Rodney Diaz, except where noted.

Illustrated Guide to Code Changes

Here's what you can expect in the 2015 IRC

BY GLENN MATHEWSON



BUILDING ELECTRICAL DECKS PLUMBING AND MECHANICAL

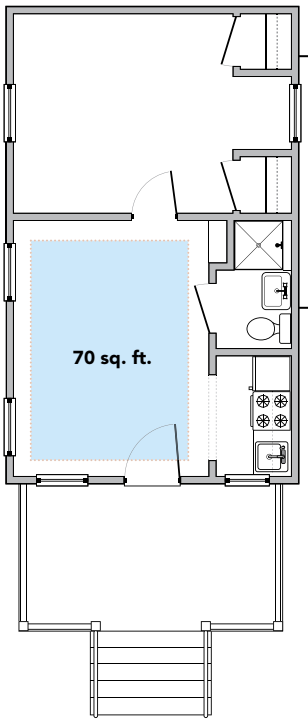
The latest building-code requirements typically start becoming the law of the land a year after they're published, so it won't be long before you'll need to comply with new provisions in the 2015 International Residential Code (IRC). A quick shuffle through the 902 pages of the new code book reveals that most have a black bar in the margin, signaling a change. There are hundreds of changes, but most are editorial, intended to make the respective provisions easier for builders to understand and easier for code officials to interpret. Still, there are significant changes of substance as well. Here, I highlight those that I think will have the most far-reaching effects and the ones that code officials and builders should be most aware of. The changes are grouped in four categories: building, plumbing and mechanical, electrical, and decks.

Glenn Mathewson is a code expert and building official in Westminster, Colo.

Drawings: Patrick Welsh

BUILDING

Fire and injury prevention is still the emphasis, but the code also reflects changes in society's attitudes. Recent revisions to the IRC brought on by tiny-house advocates demonstrate that anybody can lobby the International Code Council—which is comprised of municipal code officials and interested parties—for changes.



Room size R304.1

Tiny-house advocates convinced the ICC to shrink the minimum room size. Previous code versions required at least one 120-sq.-ft. room in every dwelling. The new minimum is 70 sq. ft., plus a bathroom.

Joist spans R502.3

After remaining unchanged for many years, span tables for joists have been revised. There's been a reduction in maximum span for joists made of southern pine and a slight increase in allowable spans for Douglas fir and hem-fir.

JOIST SPANS
40 psf live load, 20 psf dead load

		2x10	2x12
2012	**#2 Southern pine** (16 in. o.c.)	14 ft. 8 in.	17 ft. 2 in.
2015	**#2 Southern pine** (16 in. o.c.)	12 ft. 10 in.	15 ft. 1 in.
2012	**#2 Douglas fir** (16 in. o.c.)	14 ft. 1 in.	16 ft. 3 in.
2015	**#2 Douglas fir** (16 in. o.c.)	14 ft. 3 in.	16 ft. 6 in.

Smoke alarms R314.1–R314.7

To limit false alarms, smoke alarms now must be at least 3 ft. from bathroom doors. In addition, alarms with a photoelectric sensor must be at least 6 ft. from cooking appliances; ionization detectors must be at least 20 ft. away. Carbon-monoxide alarms must be hard-wired to the building power and are now required in bedrooms when a fuel-fired appliance such as a gas fireplace is in the bedroom or in an attached bathroom.

Ceiling heights R305.1

The minimum ceiling height in laundry areas, powder rooms, and bathrooms has been reduced from 7 ft. in the 2012 version of the IRC to 6 ft. 8 in. in the new version. The change should make it easier to install pipes, ducts, and mechanical equipment in these spaces because of the lowered ceiling.

ELECTRICAL

Electrical codes in the IRC come from the National Electrical Code (NEC), published by the National Fire Protection Association (NFPA). Like the IRC, this code is on a three-year cycle; however, it comes out one year earlier, so it's the 2014 NEC provisions that are found in the 2015 IRC.

Additional GFCIs E3902.8–E3902.10

All receptacles in laundry areas must now be protected by an easily accessible ground-fault circuit interrupter (GFCI). You'll also need GFCI protection for garbage disposals and for locations within 6 ft. of a bathtub or shower, even if they are outside the bathroom.

Arc-fault protection E3902.16

The electrical code now requires arc-fault circuit-interrupter (AFCI) outlets in nearly every room of the house except bathrooms, unfinished basements, garages, and outdoors. Protection can come from either an AFCI breaker or an AFCI receptacle installed in the first outlet box on a branch circuit.

DECKS

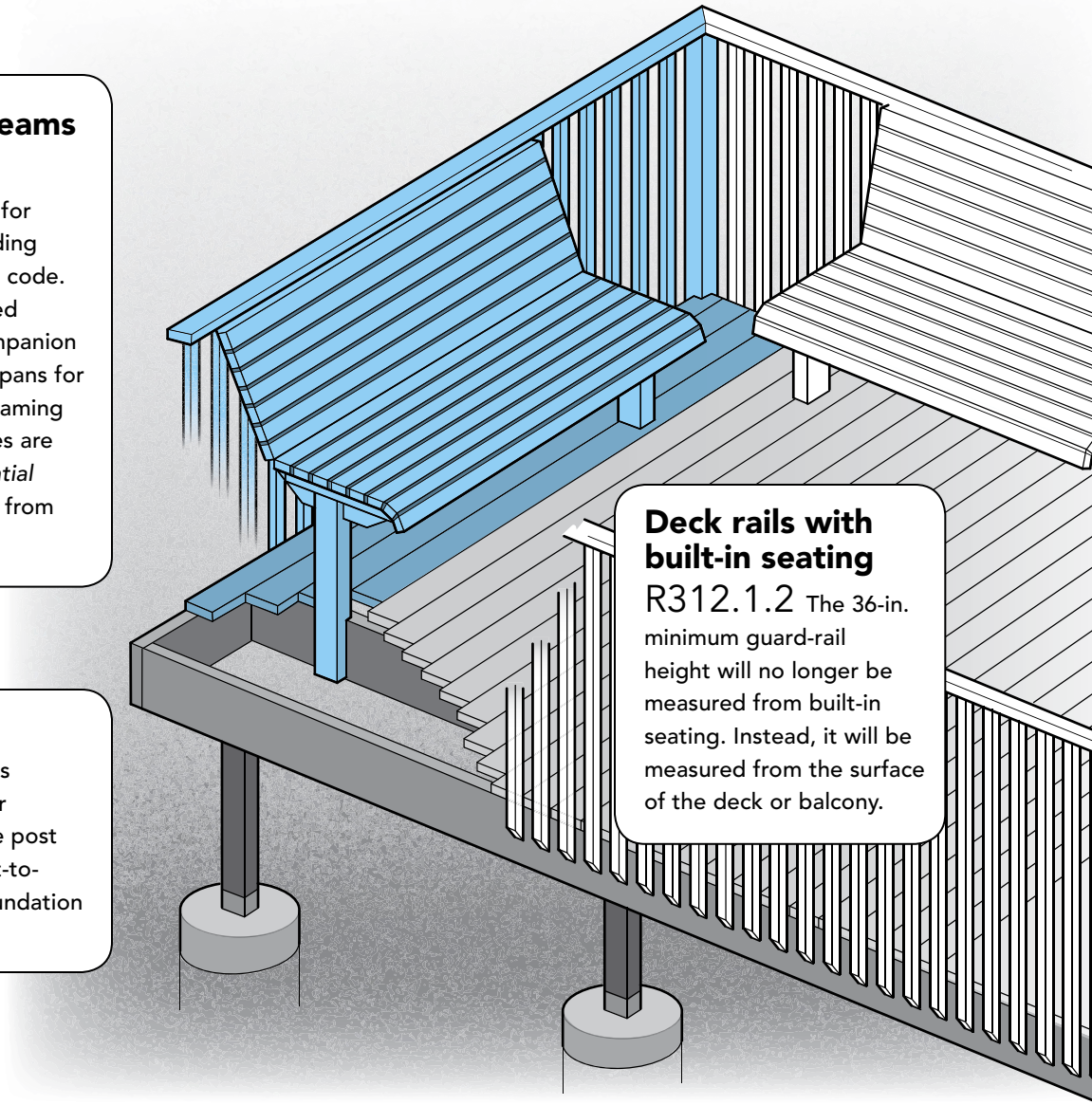
Although previous versions of the code glossed over deck construction, elevated wood decks are fully covered in the 2015 version of the IRC. No longer do builders and inspectors have to make their best guess as to a deck's compliance; now the rules are spelled out fully.

Deck joists and deck beams
R507.5 and R507.6

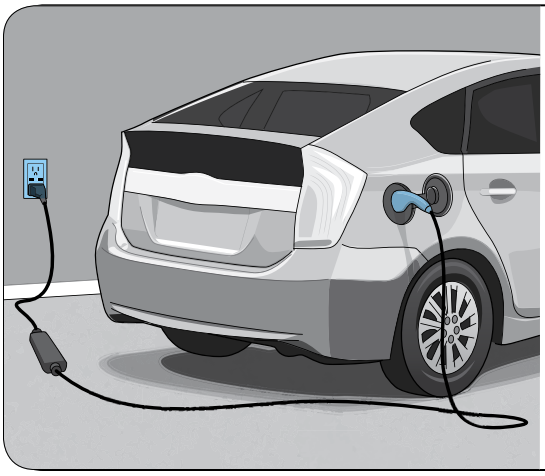
New "wet-condition" span tables for joists and beams outside the building envelope have been added to the code. Allowable cantilevers over dropped beams are also specified. The companion table R507.5 provides maximum spans for all three common types of deck framing lumber. The new deck-related rules are based on the *Prescriptive Residential Deck Construction Guide* (DCA 6) from the American Wood Council.

Posts R507.8

Limits of 8 ft. for 4x4 and 4x6 posts and 14 ft. for 6x6 posts finally offer prescriptive guidance for allowable post length. Deck-board fastening, post-to-beam connections, and post-to-foundation connections are specified also.



Deck rails with built-in seating
R312.1.2 The 36-in. minimum guard-rail height will no longer be measured from built-in seating. Instead, it will be measured from the surface of the deck or balcony.



Garage receptacles
E3901.9

The increasing popularity of electric cars drove the requirement for additional outlets in the garage. Now all vehicle spaces in a garage must be provided with their own GFCI-protected receptacle. Also, all circuits serving receptacles in the garage can serve no other indoor or outdoor locations.

Every switch needs a neutral E4001.15

With the increased use of motion detectors, illuminated switches, and other "smart" switch devices, all switch locations (with a few exceptions) are required to have a neutral (grounded conductor) in the box. In certain arrangements, three-way switches now require a four-conductor cable.

PLUMBING AND MECHANICAL

Many of the plumbing-code changes will be cheered by plumbers everywhere. The code also addresses increased attention to water conservation with seven new pages describing rainwater and gray-water collection.

Insulation under pipes N1102.2.8

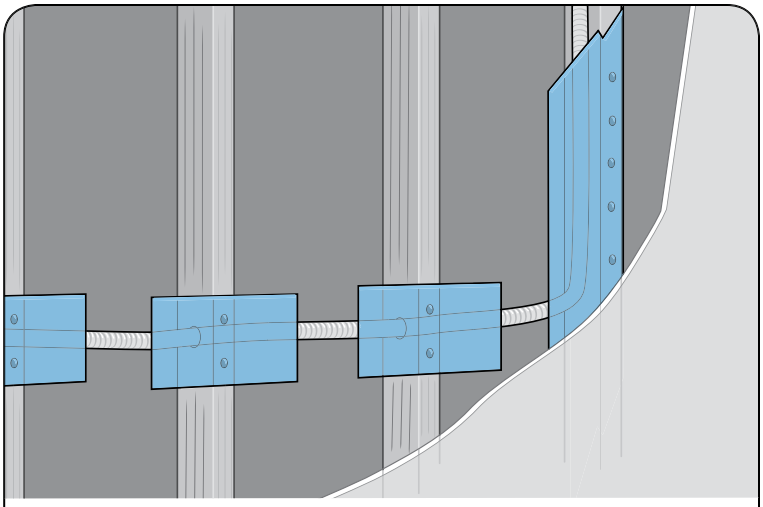
Floor insulation works best when it's in contact with the underside of the floor sheathing, so this is what the IRC has required for years. When pipes or ducts are run through the floor system, however, this puts them outside the conditioned envelope. The result is wasted energy and pipes prone to freezing. You can now use continuous insulation beneath the floor framing to bring pipes and ducts within the building envelope. However, the rim joist must be insulated to the R-value required for walls.

Forget about PVC primer P3003.9.2

The telltale drips of purple primer on white PVC drain-and-vent piping will become a thing of the past. National Sanitary Foundation testing reveals that the primer isn't necessary on unpressurized pipes of 4 in. dia. or less.

Relaxed nail-plate rules P2603.2.1

The longstanding 1½-in. distance from the edge of a framing member to a pipe has been reduced to 1¼ in., which is in line with the electric-code requirements for cables and the mechanical-code requirements for dryer vents. The change should make it easier to run pipe and tubing in 2x4 walls without needing nail plates.

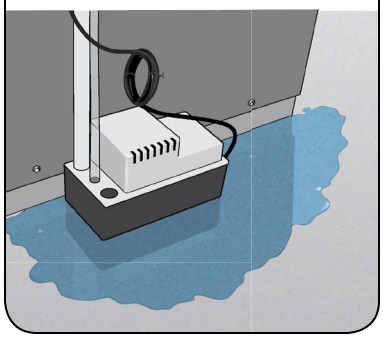


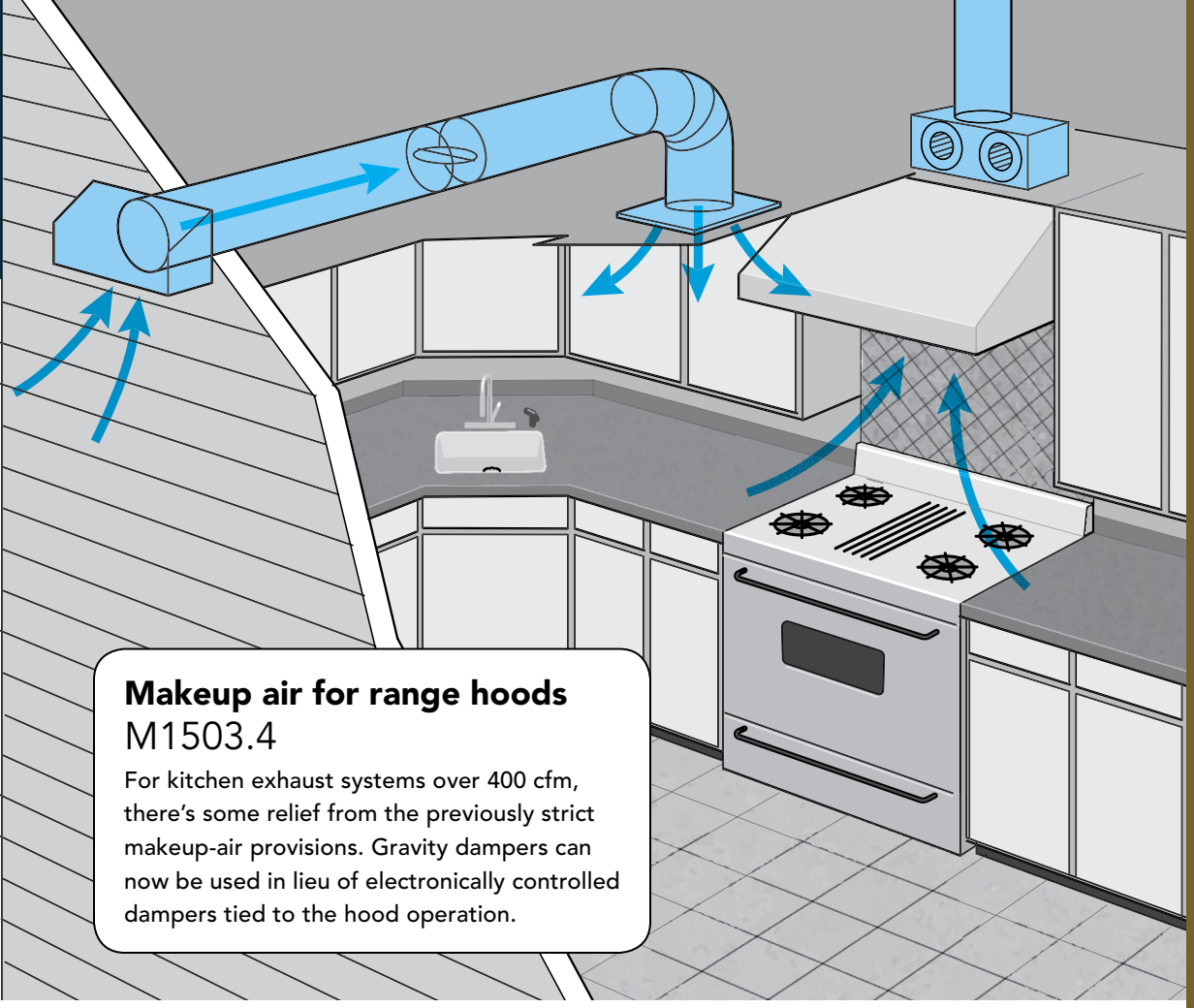
Pipes in walls G2415.7.1

While nail plates got less restrictive under plumbing codes, they became more restrictive under mechanical codes. Flexible gas and air-conditioning lines must be at least 1½ in. from stud faces or be protected with metal plates. The new rule requires that a plate extend for at least 4 in. beyond the stud edges. This is to prevent fasteners that miss the framing member from damaging the tubing. If the tubing is attached to the side of the stud, it must be at least 1½ in. away from the stud face or protected by 16-ga. flat steel for its entire length and width.

Condensate pumps G2404.11

In an effort to squeeze every available Btu from natural gas, high-efficiency furnaces and water heaters produce condensate. When you can't drain the condensate by gravity, condensate pumps are the solution, but because they're often in a basement or crawlspace, no one may notice if a pump stops working. The 2015 IRC requires a condensate pump to be wired so that when it stops, the water heater or furnace also stops. This way the occupant will know there's a problem.





Makeup air for range hoods M1503.4

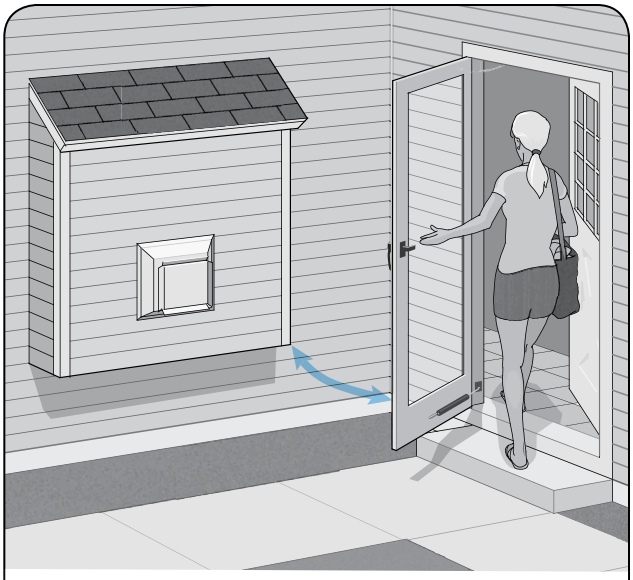
For kitchen exhaust systems over 400 cfm, there's some relief from the previously strict makeup-air provisions. Gravity dampers can now be used in lieu of electronically controlled dampers tied to the hood operation.

Cleanouts P3005.2

A plumbing cleanout is no longer required at the base of each waste stack, but the necessary space around cleanouts for access has been increased from 12 in. to 18 in.

Dryer ducts M1502.4.5

Clothes-dryer ductwork over 35 ft. long must have a permanent identification tag within 6 ft. of the dryer connection specifying its length. If the run is longer than 35 ft., the dryer manufacturer's instructions allowing the code-exceeding length must be provided during inspections. Alternatively, you can now use a booster fan for extralong dryer ducts.



Sidewall venting M1804.4

For heating equipment such as high-efficiency furnaces and gas fireplaces that vent directly through a sidewall, you now need to place vent terminations so they're at least 12 in. away from a door's swing. The rule also applies to storm and screen doors.

The code process

The International Code Council (ICC) publishes a new version of the International Residential Code (IRC) every three years. Additions and other changes are worked out ahead of the publishing date at annual hearings that move around the country. Anyone can attend the hearings or follow the proceedings live online.

Anyone can submit code-modification proposals and testify in favor of or in opposition to any code proposal during any hearing. Individuals and corporations can join the ICC, but only governmental ICC members (those members who work in municipal-code enforcement) can vote to complete the code-development cycle. Once the new version of the IRC is published, it's up to the individual states and municipalities to adopt it.

The adoption process and schedule are unique to each state, municipality, and code-enforcement office. In many instances, a state or municipality will keep a previous version of the code in place well after a new version has been released. For example, some states will adopt the 2015 IRC by the end of 2016, but the new code is unlikely to be mainstream until 2017. Hearings for the 2018 IRC will occur throughout 2016, with the final vote occurring in October 2016.

Spaces within Spaces

Thoughtfully designed nooks offer refuge and comfort in the hustle and bustle of larger rooms

BY MARK HUTKER

The houses we build are meant for family gathering. Increasingly, that means creating hybrid spaces that can accommodate large groups when the whole family is present but that also feel comfortable for just Mom and Dad. The key is to create spaces within spaces—nooks and recesses with their own unique attributes that create intimacy in bigger rooms.

Inhabiting these spaces can be very pleasing. Being half in and half out of a public space fosters the feeling of being connected to people and activities while experiencing the shelter, relative privacy, or utility of a smaller, customized haven. We often make desirable berths out of edges and corners of rooms that might otherwise be underused, turning them into breakfast spots, window seats, and even playful hideouts for children. Purposeful lighting, custom cushions, and built-in storage bays are little luxuries that enhance the specific identities of these alcoves.

Mark Hutker, FAIA, has been practicing architecture for over 30 years. He owns Hutker Architects on Cape Cod in Massachusetts.

4 DESIGN TOUCHSTONES

To inform the design of spaces within spaces, focus on four main aspects:

Scalability Can a large room have one or more smaller, ancillary spaces that function with the whole as well as independently?

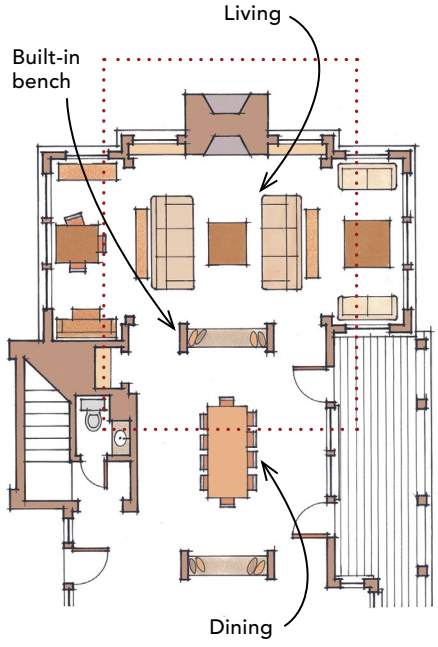
Adjacency Do the rooms relate to one another in ways that make sense for a variety of inhabitants and activities?

Material and thematic connection How will the smaller spaces relate to the larger ones?

Right-sizing Does the room's size foster the kinds of activities it is designed for?

Photos this page and facing page: Brian Vanden Brink. Floor-plan drawings: Martha Garstang Hill.

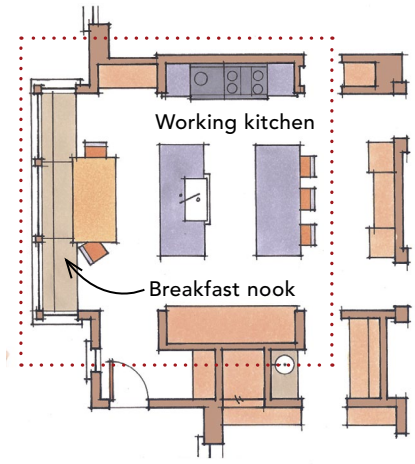
Great-room island



The clients who commissioned this great room wanted a space that would be comfortable for both large family gatherings and intimate weekends. Vaulted ceilings and two stories of windows bring light and openness to the living room, making it a dynamic space for entertaining. A lower, wood-paneled ceiling gives the dining area a more intimate atmosphere for meals. The built-in bench nestled between the living and dining areas takes this intimacy to an even smaller scale, providing a harbor that's perfect for a nap or additional living-room seating when needed. Clear wood trim helps to link all three spaces.

Cooking and eating

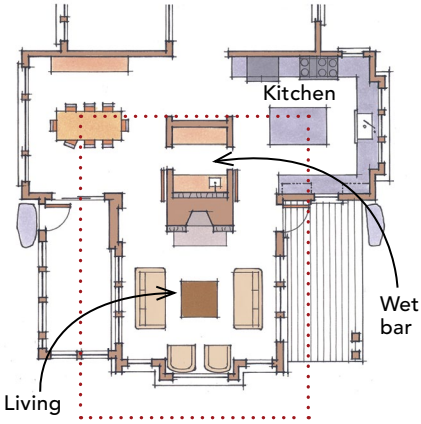
This farmhouse kitchen is broken into several different spaces that are thematically linked by shapes yet separated by material choices. Two large islands and a niche for the custom range create distinct, rectangular work zones. To create a visual link between these zones, the same stone is used for their counters. A rectangular, weathered-wood dining table breaks materially from the other zones, suggesting a shift in purpose: from the work of preparing meals to relaxing and eating. Scaled for conversation and comfort, the table and a custom bench occupy a nook that is surrounded on three sides by windows. Timber framing traverses the entire kitchen ceiling, in simple spans across the working areas and in a more elaborate pattern above the dining nook.



Photos this page and facing page: Eric Roth

Hearth and bar

The focal point of this home's great room is a central fireplace that allows circular movement between the great room and the kitchen and dining areas. A wet bar hidden behind the fireplace creates a sheltered eddy for private conversations. Fostering this sense of shelter at the wet bar is a low pergola that contrasts with the high, timber-trussed ceilings of the overall space. Exposed stonework connects this interstitial space to the great room, while its cabinetry links it to the kitchen beyond.



Fine wine storing

Archaeological evidence tells us that humans were enjoying wine as far back as 6000 B.C. A perishable product, wine will soon spoil if exposed to extreme fluctuations in temperature or humidity. When properly stored, however, wine not only will maintain its quality but may actually improve as it matures. Our ancient ancestors discovered this and so created the first wine cellars in cool, dark caves, where their wines were protected from harsh sunlight and temperature variations.

Eight thousand years later, we're still enjoying wine. And while most experts recommend for both short-term storage and long-term aging that wine be kept at between 50°F and 59°F, we no longer need a nearby cave in which to store that extra one or two—or few hundred—bottles. Today's wine aficionados have both passive and active options for storing their collections of fine wine.

Passive wine cellars include naturally cool and humid caves as well as man-made earthen cellars without added systems to control the environment. Active wine cellars have monitoring and cooling systems, artificial humidifiers, and seals.

Architect Frank Wardley, Pitman & Wardley Architects, Salem, Mass.; pitmanandwardley.com
Cabinetry Mark Welling, Ipswich Cabinetry, Ipswich, Mass.; ipswichcabinetry.com
Photographer Brian Vanden Brink, brianvandenbrink.com

BOTTLES AND BRICKS

A true wine cellar, this 12-ft. by 16-ft. temperature- and humidity-controlled wine storage space was included in the original design for the lower level of a new home on New Hampshire's Lake Winnipesaukee. The cellar was planned as a space in which to enjoy being around the bottles of wine and to relate the tale of a bottle's history before uncorking that bottle with friends and family. The wine racks built into each arched brick niche can accommodate approximately five cases of wine. Niches not outfitted with racks can hold up to twenty cases. Although not structural, full bricks were used to create the niches in order to provide the desired detailing and Old World ambience of the cellar. Recesses incorporated into one of the brick walls creates additional space for wine storage and serves as an interesting design element. The custom wet bar is built of Honduras mahogany. It is topped with a custom copper counter and has an integrated drain board and sink for washing glasses and catching errant wine. The gently curved bottom of the wine-glass storage cabinet above the wet bar complements the arched brick niches. The cabinet's glass-paneled doors display wine glasses at the ready for an impromptu tasting.

MEDIA AND MERLOT

Adjacent to the media lounge and bar in this finished lower level is a wine room with about 200 sq. ft. of storage space for red wine and a separate 30-sq.-ft. chamber kept cooler for white and sparkling wine. The custom table in the center of the room for opening and tasting wine also has a storage area for magnums. The room's climate is controlled by a ducted minisplit system located above the white-wine storage space. Compressors are located in the mechanical room. Before designing the room, the architects met with a wine-storage consultant to refine assumptions about the cooling requirements and optimum bottle angle and spacing. They also worked with a steel fabricator, cabinetmaker, and electrician. Mockups were made to test various bottle sizes and storage options before settling on the final design. The wood slats that hold the bottles are made of unvarnished laminated mahogany. The steel supports were detailed to hide their floor and ceiling fasteners and to conceal the wiring.

Architect Mark Larson, Rehkamp Larson Architects, Minneapolis, rehkamplarson.com
Builder Hagstrom Builder, Lake Elmo, Minn.; hagstrombuilder.com
Interior design Baker Court Interiors, St. Paul, Minn.; bakercourtinteriors.com
Photograph Ken Gutmaker, kengutmaker.com

WINE-AND-DINE ROOM

When you have so much lovely wine to share with your guests and every bottle has a story, why hide it away in the cellar? That was the thinking of the homeowners and collectors who chose to incorporate this 8-ft. by 9-ft. glass-fronted wine storage unit along one wall of their dining room. The unit is 2 ft. deep, can accommodate approximately 450 bottles of wine, and is temperature and humidity controlled.

Storage design Cliff Deetjen, Peregrine Design Build, South Burlington, Vt.; peregrinedesignbuild.com
Lead carpenter Jeremy Ross, Peregrine Design Build
Photograph Susan Teare, susanteare.com

BORDEAUX IN THE BARN

This wine cellar is located in a circa-1760 Massachusetts dairy barn now used for entertaining. The homeowners enjoy inviting their guests to the cellar to select a bottle of wine to accompany dinner. The racks in the 10-ft. by 16-ft. room can store approximately 50 cases of wine. Sections of the racks were fabricated with boards salvaged from another old barn on the site. The vaulted brick ceiling was inspired by the arched openings of the large masonry chimneys original to the home. The trompe-l'oeil mural's design was the outcome of a discussion between the homeowners and the artist. The antique sconces and tile were sourced by the builder, who also purchased the entry door from a salvage yard. The door's shuttered sides were sealed with glass for interior climate control. The mechanicals for controlling the temperature and humidity are outside of the room and ducted into the space through black cast-iron grilles.

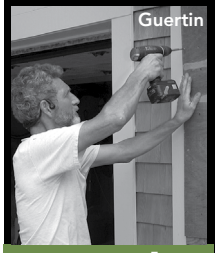
Builder Jeffrey W. Adams, J. W. Adams Construction, Concord, Mass.

Mural George Paicopoulos, Fine European Painting, Mendon, Mass.

Photograph Brian Vanden Brink, brianvandenbrink.com

ask the experts

YOUR QUESTIONS—PRO ANSWERS



experts

Martin Holladay is a senior editor at *Fine Homebuilding*. His weekly blog at GreenBuildingAdvisor.com focuses on energy-efficient residential construction.

Editorial adviser **Mike Guertin** is a builder and remodeler who has written over 100 articles for *Fine Homebuilding* and appeared in dozens of videos.

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Get answers you can trust from the experienced pros at *FHB*. Email your question to Experts@FineHomebuilding.com.

Adequate roof venting

I am having the shingles replaced on the roof of my ranch-style house. The roofer is concerned about attic ventilation and recommends installing a ridge vent and closing off the existing gable vents. He also says that the rectangular metal soffit vents may not be adequate and recommends installing more to eliminate the risk of the roof sheathing rotting. There are five vents in each soffit, and they measure about 4 in. by 16 in. each. Is it necessary to close off the gable vents? If so, how can I do that? Do I have to remove them and fill in the void with siding?

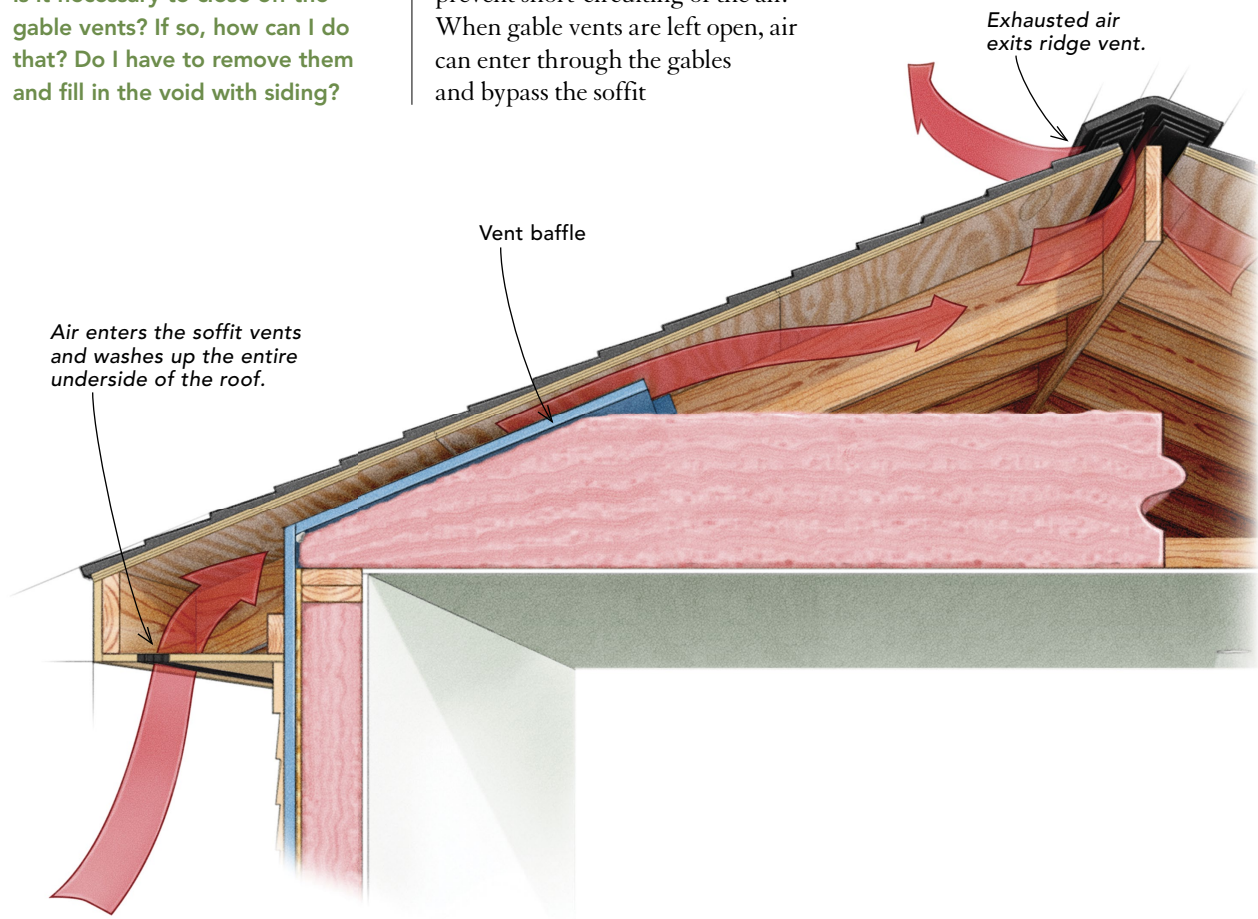
And how do I know how many soffit vents to install?

—MARK VILLAR
Middletown, Conn.

Mike Guertin: If the roof sheathing hasn't begun to rot already, it's unlikely that replacing the roof shingles will cause it to occur. Still, it's a good idea to address ventilation to reduce attic heat in the summer and to reduce the chance for ice dams in the winter.

Most likely, the roofer is recommending closing off the gable vents when adding a ridge vent to prevent short-circuiting of the air. When gable vents are left open, air can enter through the gables and bypass the soffit vents. If air flows in through the gables and out the ridge vents, the entire roof doesn't receive the full effect. The air isn't entering through the soffit vents, traveling up the underside of the roof, and exiting through the ridge vent. You don't have to remove the gable vents, though. Just screw a piece of rigid foam or plywood over the vent from the inside. When the siding is replaced, the old gable vents can be removed and the openings filled.

The standard equation for older homes that don't



Photos this page: *FHB* staff. Drawing: John Hartman.

have air barriers and vapor retarders (now required) is 1 sq. ft. of vent area for every 150 sq. ft. of attic floor. If your house is 26 ft. wide by 48 ft. long, you have a 1248-sq.-ft. attic floor and need 8.32 sq. ft. of total vent area. If, however, the attic floor has been air-sealed and has a vapor retarder between the inside of the house and the attic, the equation is 1 sq. ft. of vent area for every 300 sq. ft. of attic floor.

Ideally, this 8.32-sq.-ft. total vent area is split: 4.16 sq. ft at the ridge and 4.16 sq. ft. at the soffits. Each type of vent has a range of effective vent area per linear foot—this is called the net free vent area (NFVA). Ridge-vent NFVA ranges from 14 sq. in. to 18 sq. in. per lin. ft. (Check manufacturers' instructions for the ratings of specific products.) If 46 ft. of ridge vent (often it does not extend to the ends) is installed and the product has an NFVA of 15 sq. in. per lin. ft., we can take 46 ft. and multiply it by 15 sq. in., which equals 690 sq. in. Converted to square feet (690 divided by 144), the total is 4.8 sq. ft. This ridge vent supplies 4.8 sq. ft. of NFVA, which is just over half of 8.32 sq. ft.

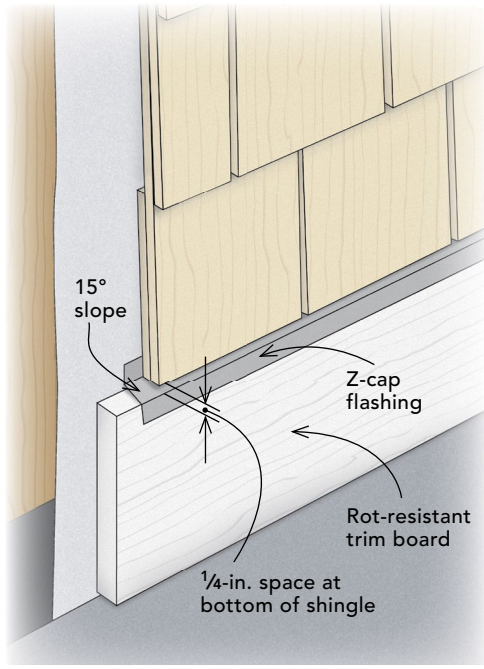
You can't have too much soffit venting, but it's worth noting the minimum requirements. Usually, 4-in. by 16-in. soffit vents are rated for 26 sq. in. of NFVA each. With a total of 10 vents, you have a total of 260 sq. in. (1.8 sq. ft.) of soffit-vent area. Since you need at least 4.16 sq. ft. of NFVA, you'll need to add 14 more of the 4-in. by 16-in. soffit vents (for a total of 4.3 sq. ft. of NFVA in the soffits). If the soffits are wide enough, you can remove the existing vents and replace them with 8-in. by 16-in. vents, which provide 65 sq. in. of NFVA per vent. With 10 of these large vents, you'll end up with a more adequate 4.5 sq. ft. of NFVA in the soffits.

Fiber-cement siding problem

My six-year-old house is clad with James Hardie's HardieShingle fiber-cement shingles. The bottom course around my entryway is deteriorating. I thought I damaged the shingles when shoveling snow, but on closer inspection, they seem to be crumbling into chunks and powder. The bottom 2 in. to 3 in. on most of the shingles is suffering this problem, with some shingles crumbling as high as 5 in. to 6 in.

First, what's causing this problem? Second, will the rest of the shingles on the house deteriorate over time? Third, can the shingles that are damaged be repaired?

—ROB KIDDER
via email



M.G.: As indicated in the instructions, HardieShingles must be kept at least 2 in. above horizontal surfaces such as decks, patios, and roofs. Many of today's manufactured siding, trim, decking, and roofing materials must be installed with spacing to permit expansion and to reduce the chance of wicking water.

Even though the HardieShingles on your house were factory finished, moisture probably wicked into the material on warm days during the winter. Then when temperatures dropped, the water inside the shingles froze, expanded, and crumbled the material. In addition to the freeze-thaw-freeze problem, any salt (calcium chloride or sodium chloride) that you may have used to break up the ice at the entryway likely attacked the shingles and accelerated the damage.

The rest of the shingles should be fine. Thoroughly check for spots where paint has chipped off the shingles, and spot-prime and paint them. If there are places where the shingles are covered or just too close to the grade, dig them out so that there is at least 6 in. of clearance.

I recommend cutting the damaged shingles about 7 in. up from the landing surface and stair steps. The remaining shingles can be pried slightly off the wall and cap flashing slipped behind them. Then a cellular-PVC or other water-impervious trim such as Boral TruExterior that the manufacturer permits to be in direct or close contact with horizontal surfaces can be installed. James Hardie recommends that the cap flashing be left at least ¼ in. below the bottom of the shingles and that the cut ends of the siding be primed with a high-quality latex primer such as Kilz 2 Latex and painted with a latex topcoat. I also recommend that the cap flashing be bent at a 15° slope so water doesn't sit on top of the cap.

Drawing this page: Kelly Dunton

Water-level issues

I'm framing a house and need to level the mudsills. I don't have a laser, and it isn't in the budget, so I'm using some clear plastic tubing I've had for a while as a water level. My problem is that the ends of the water in the 30-ft.-long tube are about ½ in. off. Any thoughts on what I'm doing wrong and how to correct it?

—CARLOS
via email

M.G.: Water seeks level even in a long hose, and assuming that you haven't just discovered you are ½ in. out of level, there are a few conditions that can skunk you. First, the hose needs to have an inside diameter of at least ⅜ in. I've tried using ¼-in. tubing, and for some reason the meniscus at one end can climb higher up the tubing wall than the other. Also, solid debris inside the tubing—sand, cobwebs, dust—can cause the water levels to be different. The same goes for liquid residue; if the tube has had oil, soap, or another liquid in it, the residue can mix (or not) with the water and cause mismatched menisci.

There can't be any bubbles of air in the water. I have found that the best way to get a bubble-free fill is to siphon water from a pail rather than holding the tube under a faucet, where the water stream can contain tiny air bubbles. To clear air bubbles, you need to hold the ends of the tubing high so that the tubing is completely suspended—and then wait. It can take a few minutes for tiny bubbles to rise out of a narrow-diameter tube. At a two-story house, I hang the tubing out a second-story window. Tapping the tubing lightly can help the air bubbles move upward rather than clinging to the side.

The temperature of the water matters, too. Make sure that part of the tubing isn't exposed to sun for long periods while another part is in the shade. Lastly, check the ends periodically to make sure the water levels match.

Open-cell vs. closed-cell foam

To insulate 2x4 walls and 2x6 rafter bays, a spray-foam contractor suggested closed-cell foam since I don't have a lot of framing depth and need to hit certain R-values. I thought open-cell foam was preferred when insulating roof decks and some walls. I'm using closed-cell in the basement, but is it also best upstairs, particularly against the roof deck?

—KURT McINNESS
New Hartford, Conn.

Martin Holladay: In unvented roof assemblies, open-cell foam has been associated with damp roof sheathing and sheathing rot, so closed-cell foam is usually preferred for this application. Closed-cell foam has a higher R-value per inch and is vapor impermeable. It also will perform better below or above grade. Cold-climate builders using open-cell foam in an unvented roof assembly can reduce the chance of damp roof sheathing by installing drywall painted with vapor-retarder paint. Hot-climate builders need to heat the attic during the winter and cool it during the summer.

Photos this page: top, Andy Engel; bottom, Rob Yagid

Call for Entries

It won't be in print until the fall, but we're already scouting for our next *Kitchens & Baths* annual issue. We're interested in brand-new or recently remodeled projects of every style from all over the country. And we're not looking only for big, luxuriant kitchens and baths; well-designed projects done on a tight budget are dear to our hearts. But big or small, expensive or thrifty, they must be highly functional and beautifully crafted.

Send us decent color images and a brief description explaining which aspects of your project might prove interesting to our readers. We prefer online submissions at **FineHomebuilding.com/kitchen-bath-submissions**. We are also happy to receive email submissions at fhcallforentries@taunton.com (7MB maximum file) or to review CDs or hard copies of your materials, which you can send to *Kitchens & Baths, Fine Homebuilding*, 63 S. Main St., P.O. Box 5506, Newtown, CT 06470-5506.

Entries deadline
February 12, 2016

Photo: Whit Preston

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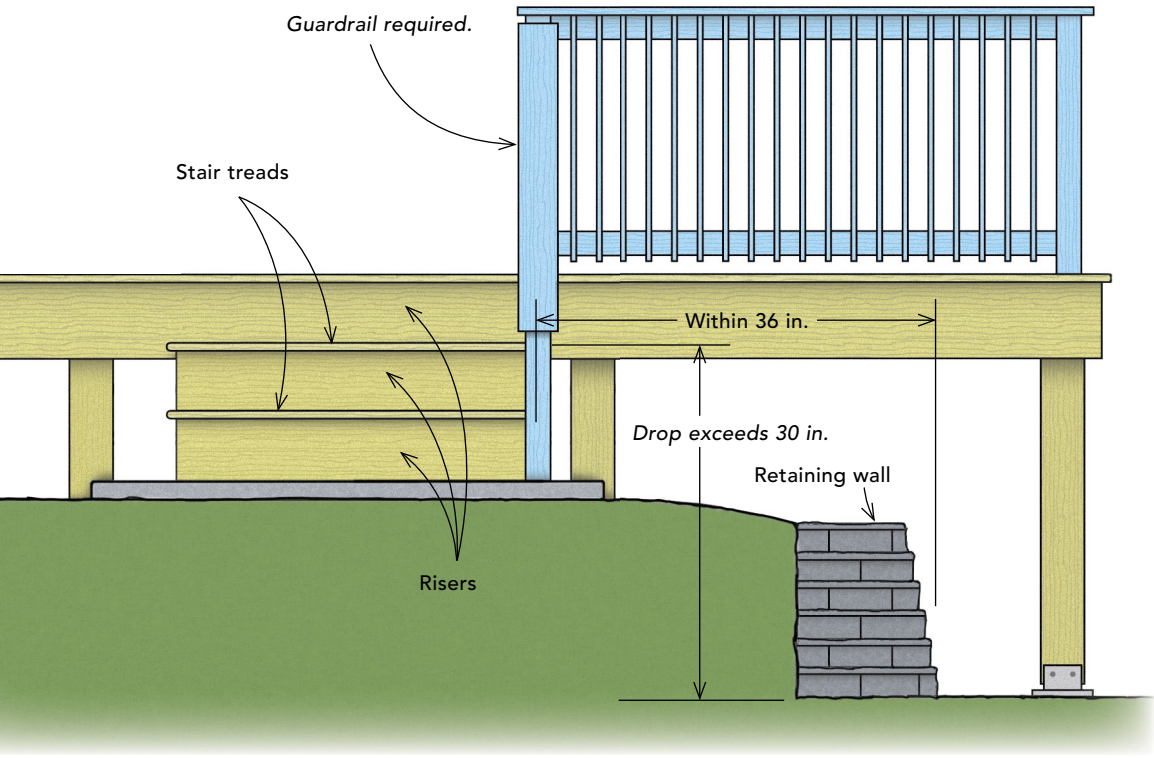

Handrail required?

I'm building stairs on a new deck and want to clarify if the building code requires a handrail. There will be two 11-in.-wide treads and three 7½-in. risers. I've read that the 2015 IRC requires a handrail on at least one side of stairs with four or more risers, so am I right in thinking that I can build with no handrail?

—PETER LEWIS
East Windsor, Conn.

M.G.: Since your stairs will have only three risers, you don't need to install a handrail. That said, it's important to count the number of risers accurately. Some people equate the number of treads with the number of risers and omit the last riser from the top tread to the deck surface; it is indeed a riser and must be counted. The number of risers is generally one more than the number of stair treads.

You may not need a handrail to comply with code, but you may have to install a guardrail. A handrail is simply the rail you grab onto so that you can steady yourself when climbing or descending stairs. A guardrail is the structural rail, posts, and infill (often balusters) that prevent falling off the side of a deck or stairway. Whenever the distance from grade to the walking surface above is greater than 30 in. above any point within 36 in. horizontally, you need to install a guardrail. This includes stairs, measured from the top tread.

The drawing here shows a build where there are only three risers, so a handrail is not required. On the right side, however, is a retaining wall, and the grade drops more than 30 in. below the top stair tread. Because of the drop in the grade to the right side of the stairs, a guardrail needs to be installed (and the deck surface also needs a guardrail on that side).

Blower-door test record

I had a blower-door test performed on my house to satisfy code requirements. The result was 0.11 ACH50. I was expecting the house to be tight, but not necessarily that tight. Is this some sort of record? The only thing I have been able to find is an article about a house in Alaska that was recognized as the tightest in the world. Any information on where I might look or whom I could contact would be appreciated.

—MATT BERKHEIMER
Liberty, Pa.

M.H.: Congratulations on achieving an excellent result on your blower-door test. Your house is significantly tighter than what is needed to reach the Passive House standard. Other homes are tighter, however. According to an article published at GreenBuilding Advisor.com, David Posluszny's Massachusetts house was tested at 0.09 ACH50, and at the house you refer to in Dillingham, Alaska, the blower-door result was 0.05 ACH50. Although your blower-door test didn't achieve a record, it is nevertheless impressive.

Photo this page: Patrick McCombe. Drawing this page: Kelly Dunton.

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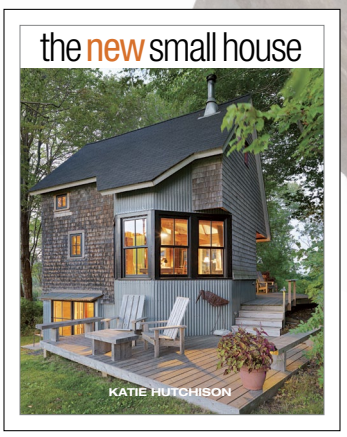

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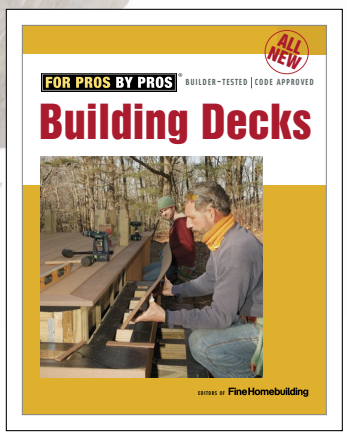

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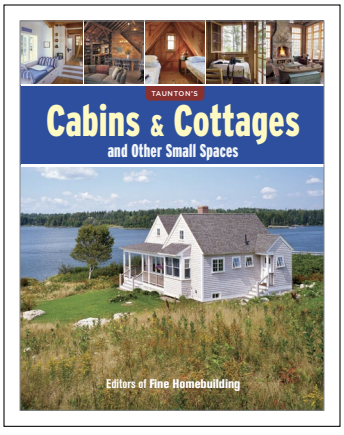

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BY MARTIN HOLLADAY

Heat loss through footings

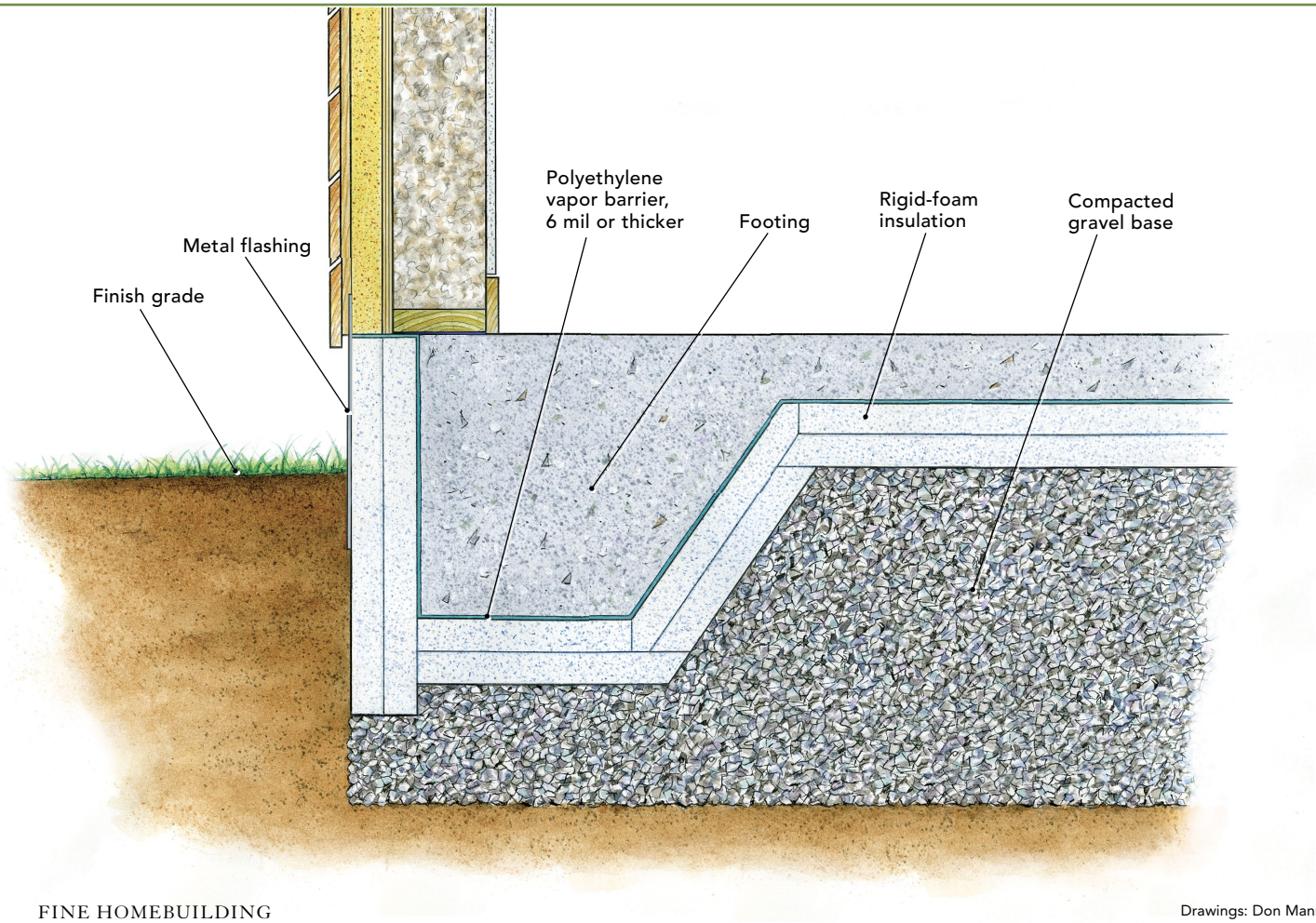
Some types of foundations can lose heat through concrete footings. Fortunately, heat loss through footings is usually minor, so it's perfectly reasonable for most builders to ignore the issue. The amount of heat that flows through a concrete footing depends on the depth of the footing (shallow footings lose more heat than deep footings), the climate, and the builder's performance goal. If the goal is to meet a strict standard such as Passive House, addressing this thermal bridge may be important.

On foundations with stemwalls, including basements, thermal bridging through footings can be addressed by installing insulation on the interior of the stemwalls and by including a continuous horizontal layer of rigid foam under the slab. For other foundation types, including slabs on grade, it may be necessary to install rigid foam under the footings or to eliminate the footings completely.

Can foam support a house?

Engineers tell us that good soils should be able to support 3000 lb. per sq. ft. (20.9 psi). Most brands of extruded polystyrene (XPS) insulation, including Owens Corning Foamular and Dow Styrofoam, have a vertical compressive strength of 25 psi. That's more than many soils that are routinely used to support a footing and a house. It's also possible to order high-density XPS or expanded polystyrene (EPS) with higher compressive strengths (40, 60, or even 100 psi).

INSULATED MONOLITHIC-SLAB FOUNDATION



Drawings: Don Mannes

Building scientist John Straube points out that when rigid foam supports a load, it can suffer from "creep," a type of compression that occurs slowly. "Over 50 years, the foam can shrink by 10%," he explains. As long as the creep is consistent, however, the building sitting on the foam shouldn't suffer harm. "The real problem isn't settling; it's differential settlement," says Straube. Of course, uneven settlement can damage a building. A foam manufacturer's listed compressive-strength rating may not account for creep, so it's always a good idea to consult a structural engineer before designing footings that sit on foam. Dow states that vertical compressive strength is measured at 5% deformation or at failure, whichever occurs first. To reduce the likelihood of creep leading to differential settlement, Dow recommends a safety factor of 3:1. For example, if 20 psi is desired, using 60-psi foam would prevent a problem.

Even though rigid foam can support more weight per square inch than excellent soil, local code officials may not be ready to sign off on the use of rigid foam under footings. If you plan to design a building with foam under footings, be prepared to negotiate with local code officials.

Insulated raft foundations

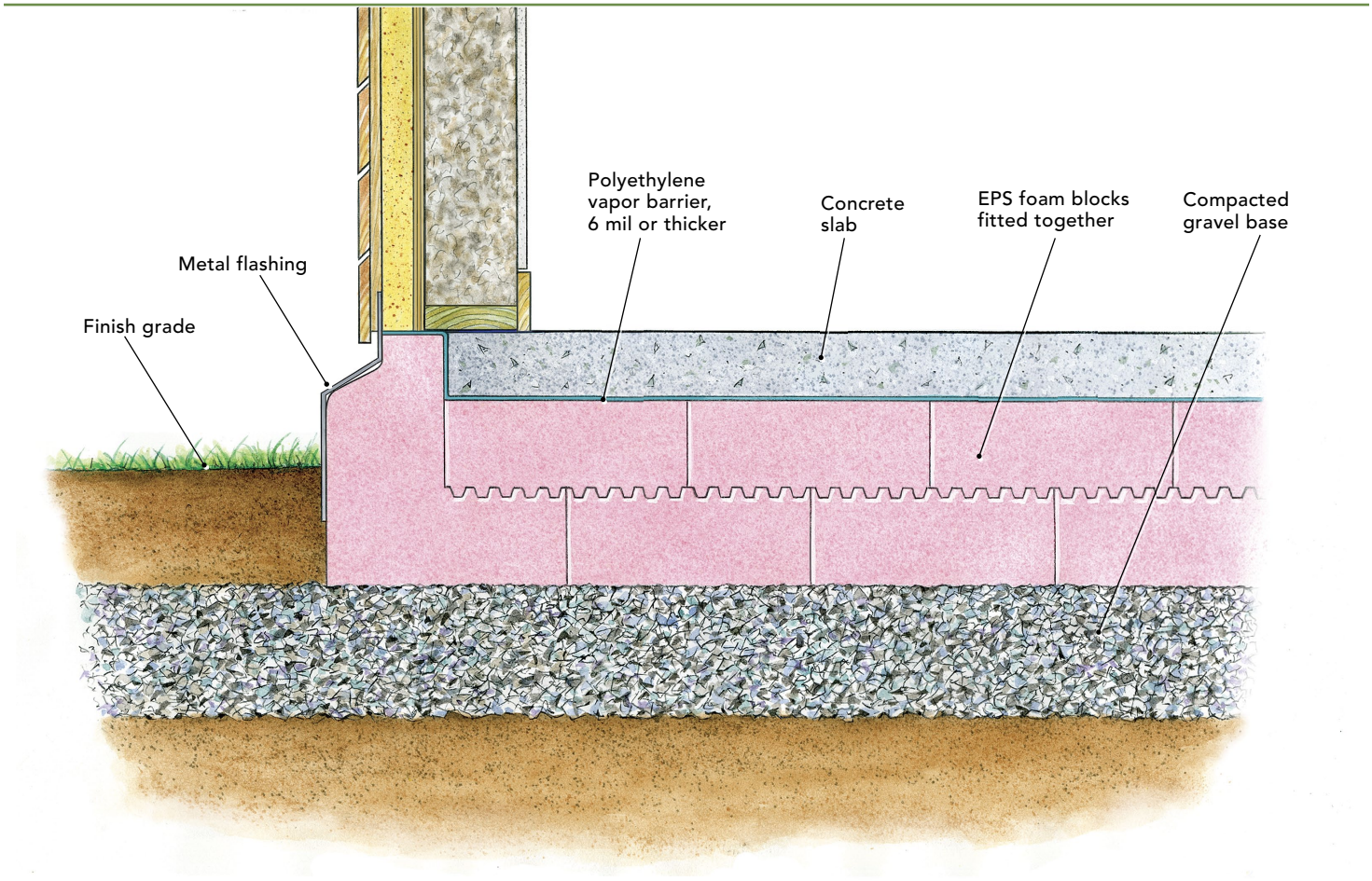
An insulated raft foundation is a load-bearing slab on grade with a uniform thickness rather than a thickened edge. The thickness of the concrete and the rebar schedule are designed to support the loads that are imposed by the perimeter walls and any interior bearing walls.

The EPS forms that are usually used for an insulated raft foundation resemble a big rectangular tray. Unlike many frost-protected shallow foundations, an insulated raft foundation has a continuous horizontal layer of rigid foam under the entire slab, as well as vertical insulation at the slab's perimeter. The perimeter insulation is often assembled from EPS blocks that snap together. After the concrete is placed, the foam forms stay put, just like insulated concrete forms. Insulated raft foundations usually don't have underground insulation extending away from the foundation (known as wing insulation), and instead depend on a deep layer of crushed stone to avoid frost heaving.

Insulated raft foundations were developed in Europe. Because of growing interest in the Passive House standard in the United States and Canada, a New Jersey company called Bygghouse now distributes insulated raft forms in North America. Builders of insulated raft foundations can also use ordinary XPS or EPS panels supported by removable perimeter forms.

Martin Holladay is a senior editor at Fine Homebuilding *and GreenBuildingAdvisor.com.*

INSULATED RAFT FOUNDATION



BY ANDY ENGEL

Cutting an acute bevel

Standard circular saws and miter saws can cut bevel angles up to about 54°. While that handles most day-to-day needs, every so often you need to make a cheek cut that a standard saw can't accommodate. For example, I recently found myself having to cut a 71° bevel on a piece of 2x6 blocking for a set of winding stairs.

The technique is simply to cut the angle on each edge of the board using a circular saw and then to connect the cuts using a reciprocating saw or a handsaw. In fact, you could make the entire cut with either of those tools, but it's hard to cut accurately with a recip saw, and using a handsaw is tedious.

Working with square-edged lumber is crucial. If the edge isn't square to the face, your cuts won't align. Careful layout also is important, because the accuracy of the second layout line depends on aligning it with the first. Likewise, the third line's accuracy depends on how it intersects the second line. Errors can accumulate rapidly.

Had he not become a Fine Homebuilding *editor in 1996, Andy Engel would be a grizzled old carpenter by now. Photos by Rodney Diaz.*

STEP BY STEP

1 *Start with square-edged stock.* *Framing lumber may be manufactured with square edges, but changes in moisture content can alter its geometry. Pick through the lumber pile to locate a piece with square edges.*

2 *Mark one edge.* *Use a T-bevel, protractor, or framing square to lay out the angle on the lumber.*

3 *Compensate for the roundover.* *The eased edges on lumber make it harder to accurately transfer the cutline from the edge to the face. Sight directly down on the T-bevel and the face of the lumber, and mark the intersection of the two.*

4 *Draw a square line on the face.* *This line determines where you mark the angle on the second edge, and it provides a reference when cutting.*

5 *Mark the angle on the second edge.* *To again compensate for the roundover, sight down on the T-bevel to align it with the square line on the lumber face, then mark the second cutline.*

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Angle-marking tools

FRAMING SQUARE

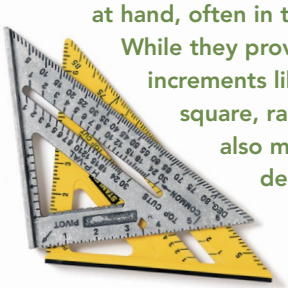
An old-school tool for laying out angles, a framing square provides angles in rafter-pitch increments, such as 12-in-12, rather than degrees. One shortcoming is that it's hard to use this tool to measure some angles, especially if the pieces being measured are short.

T-BEVEL

The simplest method of transferring angles, a T-bevel is simply held in place to duplicate an angle, and then its locking screw is tightened down. It provides no measurement increments, but transfers angles directly.

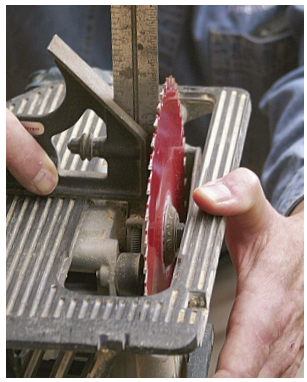
RAFTER SQUARE

Most carpenters have a rafter square at hand, often in their tool belt. While they provide rafter-pitch increments like a framing square, rafter squares also measure in degrees.



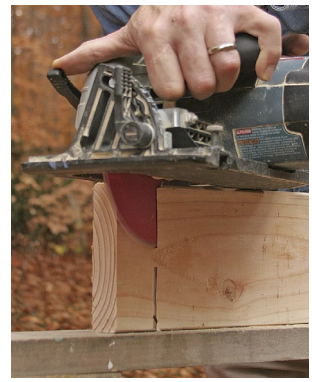
ANGLE FINDER

A bit of a specialty tool, this protractor can be used to measure angles in degrees like a rafter square, and to transfer angles directly like a T-bevel.



6 ***Set up a circular saw.*** *Use a sharp, thin-kerf blade. Don't trust the bevel settings on the saw; they're rarely accurate. Instead, use a square to ensure that the blade is at 90° relative to the saw's base.*

7 ***Make the first cut.*** *Clamp the stock in place. Set the saw's base firmly on the lumber edge, and don't rock the saw as you cut. As it exits the cut, the blade should follow the square line on the lumber.*



8 ***Flip the board over.*** *Repeat the cut from the opposite edge.*

9 ***Finish the cut.*** *A reciprocating saw makes quick work of the job, but a handsaw isn't much slower. The reason for the thin-kerf blade in the circular saw is to match more closely the kerf width of either a recip saw or a handsaw.*

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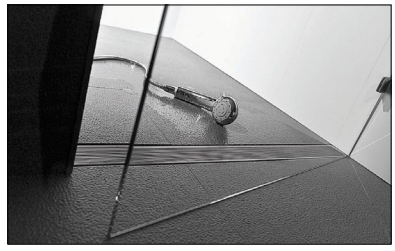

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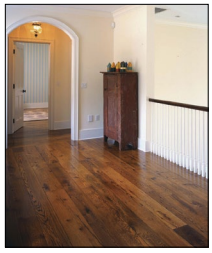

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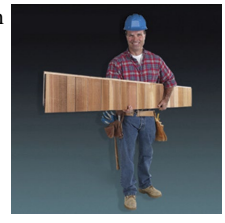

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LESSONS IN RESIDENTIAL DESIGN

BY NENA DONOVAN LEVINE

Small powder rooms

Photo: Lincoln Barbour. Design: Jessica Helgerson Interior Design.

In many houses, a small space such as a hall closet can readily be converted into a half-bath, or powder room. When bathroom rush hour hits our family, the question of whether a hall closet is more useful than a powder room doesn't even surface. There's nothing like nature's call to focus your priorities. The hall closet always loses out to the water closet.

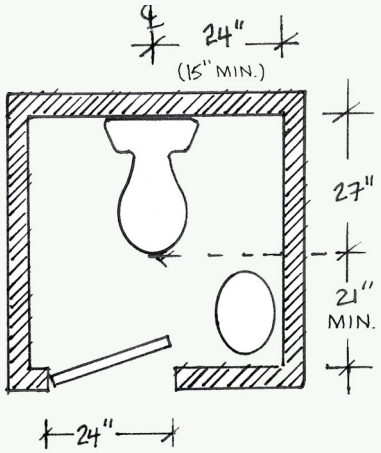
Strictly speaking, powder rooms have only a sink and a toilet, but they afford an important measure of convenience to guests and residents alike and can also add value to a home. Charles Hartigan, a real-estate agent in Avon, Conn., says that a powder room added to a home that formerly had only one full bath can mean a return of $15,000 to $20,000. Here are a few matters to consider when incorporating a powder room in a small space.

Nena Donovan Levine is a kitchen and bath designer in West Hartford, Conn. Drawings by the author.

How small can a half-bath be?

The minimum size of a powder room depends on where, geographically speaking, it will be. There is no nationwide code that governs the dimensions of residential rooms, but most jurisdictions follow the guidelines set forth by the International Residential Code. The IRC's minimum requirements for clearances and ventilation suggest certain basic configurations.

- The minimum distance from the toilet centerline to a sidewall is 15 in.
- The minimum clearance in front of the toilet bowl is 21 in.
- The minimum headroom is 7 ft.
- Windows must be at least 3 sq. ft., at least 1½ sq. ft. of which must be openable.
- A fan that provides at least 50 cfm of ventilation can substitute for a window.



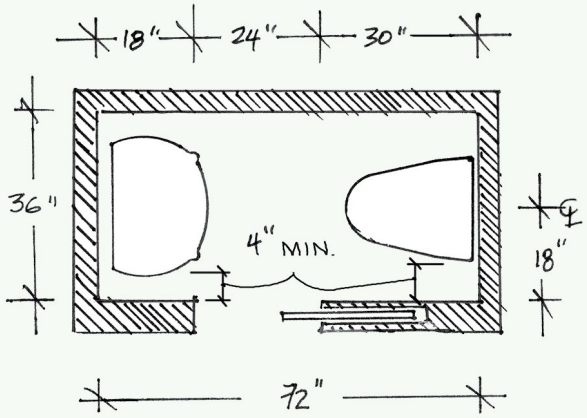
The mighty mini

At 4 ft. by 4 ft., this plan is about as small a layout as clearances permit. The sink can be a pedestal, wall-hung, or corner-mount model. The 24-in. doorway could be wider, depending on sink choice. This plan fits in a converted closet.

Door placement is a critical factor

In spaces this small, the door width, placement, and swing are pivotal. The IRC is silent on powder-room door size, and the door can swing either in or out. An out-swing door prevents the occupant from wedging the door shut in the event of a fall, and it allows more fixture-layout options.

However, an out-swing door can endanger those outside the bathroom, so consider the location of the bath in light of the foot traffic that moves in the area. If a pocket door is feasible, that may be the best option. Pocket doors take no floor space to open.



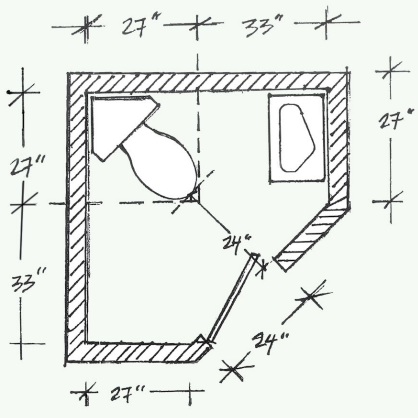
Under the stairs

A pocket door is the key to this 3-ft. by 6-ft. plan, although an out-swing door also could work. A freestanding sink works well in this plan. This powder room's shape is typical of space carved from under stairs or converted from closets.

Some fixtures were just made to be in a powder room

A simple way to adhere to code clearances in diminutive spaces is to choose similarly scaled fixtures. Sinks are available in minuscule sizes and specialty shapes, including wall-hung or inset sinks, corner sinks, and special pedestal sinks made for corners. Another option is to mount a standard-shape bowl to a pie-shape shelf or cabinet. Bowls mounted on wrought-iron or hammered-bronze pedestal stands work well in small spaces, as do long-legged wooden cabinets. Lever-action faucets fit better on small sinks than do faucets with dual controls.

If site conditions require the installation of the toilet in a corner of the powder room, be aware that the narrower the tank is, the closer the toilet will fit into the corner. A toilet that has a triangular tank is ideal for use in this application. Just a couple of inches of clearance can determine whether a half-bath is built or not. Clever solutions such as recessing the toilet tank into the wall can bail you out. For storage space, shallow cabinets can be placed between the studs.



Tucked into a corner

This 5-ft.-sq. plan with a lopped-off corner is typical of interior powder rooms off a main hallway or a stairwell landing. A toilet with a triangular tank fits handily in the far corner.

tailgate

INTERVIEW BY AARON FAGAN

LANCE KIRLEY, President and CEO This executive stewards the design of traditional homes and the manufacture of historically authentic building components.

Your father, Lloyd Kirley, started Classic Colonial Homes in 1992.

We are a family of architects and craftspeople who have been at this for generations. My grandfather was a prominent architect in central and western Massachusetts. My father and my uncle started their own company in the 1970s, and it evolved into its current configuration, which is Classic Colonial Homes (CCH). My father developed a small portfolio of reference designs and built off of those to create what we work from primarily today, which is a vast database of designs that are all in keeping with the early American theme.

Is there a secret to proportion?

There are lots of prime examples of antique buildings here in New England. My father was inspired by those and drew from their examples to try to capture, respect, and honor their essence while not being stuck in the past. It's hard not to be impacted by so many historic homes. The key to being successful in creating one of these new homes is finding the sweet spot that develops a balance of scale and proportion. It's different with each structure. We don't always default to the standardized dimensions. A house may not construct quite as economically, but it looks right. It's a matter of inches that makes the difference between an authentic and a contrived example of a classic home. We take it to that degree. People see that we do something that sets us apart from our competition, but they can't quite name it.

What inspired the company to manufacture its own products?

My father put his heart and soul into every building he designed. He was a craftsman with all materials. When I was growing up, I remember seeing him work on a forge outside our house pounding out hand-cut nails or making thumb latches. It was an outlet for his creativity in this really authentic way. He knew that with all these different elements, if they were combined into one cohesive package, it would be much more accessible to builders, who would likely benefit from it as well. They could hang their hat on such a fine structure trimmed and detailed correctly.

We're developing the working components to these millwork packages here in Leverett, Mass., using raw materials that are sourced straight from the forest. This allows us to offer a competitive price for something that is beyond compare in the marketplace in terms of quality and detail.

> **It's a matter of inches that makes the difference between an authentic and a contrived example of a classic home.**

Does energy performance factor into your designs?

It's a huge focus for our company to be able to integrate performance measures and stay true to the historic vernacular. We're always striving to look for that balance, but we're working toward net zero. It's paying homage to what has been, but thoughtfully moving things forward with performance. Fortunately, it's not just us pushing for this; our clients are asking for it. It's not a hard sell.

What's at the heart of CCH?

We put our heart and soul into our work to carry on the tradition my father started. It's been my mission since he passed away to take the company a bit more into the modern era. My father was really a traditionalist. He drew with a pencil on vellum. When we introduced him to CAD, he resisted it. Over time, though, he started to appreciate some of the benefits of having that tool.

Someone who learned at a drawing board has a difficult time transitioning. My father wouldn't allow us to go much further with that until we could prove to him that in doing so we wouldn't jeopardize the quality of the elevations that we produced. He was a stickler for lines that would break in certain areas and waver just a bit with the natural rhythm and motion of your hand. We had to convey that because CAD was so soulless, it produced great black lines that had no character or variation to them. So we had to go in and modify the CAD drawings to replicate that hand-drawn look.

My brother Keith entered a master's program in architecture at Notre Dame, and they didn't let him touch a computer until his senior year. He learned like the traditionalists did. He's a fantastic artist and got all the chops that my father and grandfather had. That talent skipped me, but he's got it. It's clearly in the blood. Our father and our uncle started an earlier rendition of what the company is today, and now we are working together in much the same way on our family property. We have a beautiful antique water-powered sawmill that predates the town of Leverett. The property has been in our family since the late 1960s when my father and uncle bought it. That's the location of the original design studio for the company. They rebuilt the turbine and used that to saw timber-frame structures.

We're set in a beautiful spot here, and I'm sure it's a driving force behind our work. Being able to further my father's and uncle's work is something we take very seriously.

For the complete interview, visit FineHomebuilding.com/extras.

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Winding down to the wine cellar

These intricate, custom railings that lead to a spacious wine cellar in a private residence were designed and created by metal artist and blacksmith Scott Lankton. Each hand-chiseled leaf and textured vine in this complex design is unique, as it would be in nature. The grapes were made individually, then painstakingly joined one by one to form each cluster. Built on-site, the railings appear to have grown up in the space. After completing the installation, Lankton applied a clear acrylic finish to the metal to preserve its warm natural patina, the result of the extensive hot-working and wire-brushing of each piece. Lankton also crafted grapevine and leaf chandeliers and room dividers, mica wall sconces, door hardware, and other forged metal-work pieces for the wine cellar. The concept, creation, and installation of the railings and other pieces took Lankton and two apprentices approximately six months to complete.

In 1985, Lankton received his diploma from the International Teaching Center for Metal Design in Aachen, Germany, after serving an apprenticeship under master Manfred Bredohl. Also trained as a jeweler, Lankton has been making "jewelry for buildings" since 1979 from his studio in Ann Arbor, Mich. —*Maureen Friedman*

IRONWORK Scott Lankton, Lankton Metal Design, Ann Arbor, Mich.; lanktonmetaldesign.com

INTERIOR DESIGN Rohn Goldman, Rohn M. Goldman Design, Huntington Woods, Mich.

ARCHITECT Bob Bryce, Bryce McCalpin Palazzola Architects & Associates, West Bloomfield, Mich.

RAILING PHOTOGRAPHS courtesy of Scott Lankton

SCOTT LANKTON PHOTOGRAPH courtesy of bradziegler.com

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